TAXONOMIC STUDY OF FERNS AND FERN ALLIES AT HUAIYANG WATERFALL NATIONAL PARK, PRACHUAP KHIRI KHAN PROVINCE

Mr. Yuttaya Yuyen

A Thesis Submitted in Partial Fulfillment of the Requirements
for the Degree of Master of Science in Botany
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จากการศึกษาอนุกรมวิธานของพืชจำพวกเฟินและกลุ่มใกล้เคียง บริเวณอุทยานแห่งชาติน้ำตกห้วยยาง จังหวัดประจวบคีรีขันธ์ ระหว่างเดือน มีนาคม 2542 – ตุลาคม 2543 สำรวจและเก็บตัวอย่างพืชกลุ่มนี้ได้ 204 ตัวอย่าง นำมาศึกษาและตรวจหาชื่อวิทยาศาสตร์ พร้อมทั้งจัดทำคำบรรยายลักษณะโดยละเอียด พร้อมข้อมูลประกอบอื่นๆ รวมถึงทำรูปวิธานจำแนกสกุลชนิดได้จำนวนทั้งสิ้น 126 ชนิด 57 สกุล 26 วงศ์ แบ่งออกเป็นกลุ่มใกล้เคียงเฟิน 11 ชนิด 4 สกุล 3 วงศ์ สำหรับวงศ์ที่พบจำนวนชนิดมากที่สุดคือวงศ์ Polypodiaceae จำนวน 26 ชนิด 14 สกุล วงศ์ที่พบจำนวนชนิดมากเป็นอันดับสองคือ วงศ์ Aspleniaceae พบจำนวน 11 ชนิด 1 สกุล วงศ์ที่พบมากเป็นอันดับที่สามคือ วงศ์ Thelypteridaceae จำนวน 10 ชนิด 1 สกุล พืชกลุ่มนี้ทั้ง 126 ชนิด แบ่งตามถิ่นอาศัยที่ขึ้นอยู่ได้ 4 แบบคือ ขึ้นบนดิน 53 ชนิด อิงอาศัย 17 ชนิด ขึ้นบนหิน 19 ชนิด และขึ้นในน้ำ 1 ชนิด พบพืชที่มีถิ่นอาศัยมากกว่า 2 แบบขึ้นไปจำนวน 36 ชนิด นอกจากนี้ยังสามารถแบ่งพืชกลุ่มนี้ตามสภาพป่าที่พบ 4 ชนิดคือ ป่าเบญจพรรณ 22 ชนิด ป่าดิบแล้ง 14 ชนิด ป่าดิบชื้น 20 ชนิด และป่าดิบเขา 34 ชนิด และมีพืชที่พบขึ้นอยู่ในสภาพป่ามากกว่า 2 ชนิดขึ้นไป จำนวน 32 ชนิด จากการศึกษามีพืชจำพวกเฟินและกลุ่มใกล้เคียง 100 ชนิดที่ไม่เคยมีรายงานว่าพบที่จังหวัดประจวบคีรีขันธ์มาก่อน และ 2 ชนิด เป็นพรรณไม้ถิ่นเดียวของไทย คือ *Crepidomanes megistostomum* (Copel.) Copel. และ *Polysticum attenuatum* Tagawa & K. Iwats. ในการศึกษาครั้งนี้ได้จัดทำ คำบรรยายลักษณะของพรรณไม้แต่ละชนิด รูปวิธานจำแนกสกุลและชนิด ข้อมูลทางนิเวศวิทยา การกระจายพันธุ์ ชื่อพื้นเมือง และการใช้ประโยชน์ พร้อมทั้งภาพประกอบ ตัวอย่างพรรณไม้แห้งของพืชจำพวกเฟินและกลุ่มใกล้เคียง เก็บรักษาไว้ที่ พิพิธภัณฑ์พืชศาสตราจารย์ กสิน สุวตะพันธุ์ ภาควิชาพฤกษศาสตร์ คณะวิทยาศาสตร์ จุฬาลงกรณ์มหาวิทยาลัย

ภาควิชา พฤกษศาสตร์ ลายมือชื่อนิสิต .....

สาขาวิชา พฤกษศาสตร์ ลายมือชื่ออาจารย์ที่ปรึกษา .....

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Taxonomic survey of ferns and fern allies at Huaiyang Waterfall National Park, Prachaup Khiri Khan Province, was carried out from March 1998 to October 2000. Two hundreds and four specimens were collected. A total of 126 species in 57 genera from 26 families were identified. Among these 11 species in 4 genera from 3 families are fern allies. Three families of true fern namely Polypodiaceae, Aspleniaceae and Thelypteridaceae are among the common families. Polypodiaceae included 26 species in 14 genera. Whilst Aspleniaceae and Thelypteridaceae included 11 and 10 species, respectively; but from each single genus. Among 126 species, there are 53 species of terrestrial plants, 17 species of epiphytes, 19 species of lithophytes and 1 species of aquatic plant. However, 36 species thrive in more than two habitats. It can be concluded that 22 species are found in Mixed Deciduous Forest. While 14 species occur in Dry Evergreen Forest. Whilst 20 species are found in Tropical Evergreen Forest, and 34 species grow naturally in Hill Evergreen Forest. Moreover 32 species may be found in more than two vegetations. Additionaly, two edemic species to Thailand occur in this study area, i.e. *Crepidomanes megistostomum* (Copel.) Copel. and *Polystichum attenuatum* Tagawa & K. Iwats. It was also found that 100 species are new records for Prachuap Khiri Khan Province. Full description of all species are given, key to genera and key to species were constructed, together with ecological data, their distribution, vernacular name and utilization. In addition photographs of collected species were also provided. The voucher specimens are deposited at The Professor Kasin Suvatabhandhu Herbarium, Department of Botany, Faculty of Science, Chulalongkorn University.

Department **Botany** Student's signature .....Yuttaya Yuyen.....

Field of study **Botany** Advisor's signature ...Thaweesakdi Boonked...

Academic year **2000** Co-advisor's signature .....-.....

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CHAPTER I

INTRODUCTION

As a tropical country, Thailand is rich in biological diversity, i.e. genetic diversity, species diversity and ecosystem diversity. Thailand has abundant forest-resources and also being a center of forestic region in South-East Asia (องค์การสวนพฤกษศาสตร์, 2539). It is a well known fact that plants were important to human dwelling since prehistoric time. Plants of various species were utilized for home consumption as foods and medicines. Clothes and house construction are also relied heavily on plant materials. Nowadays peoples use plant more extensive for cosmetics and recretional purposes. The human population continues to grow rapidly and the rate of destruction of plant habitat, with the consequential loss of species, is greater than in any other period of history. In Thailand, high diversity forest resource is being decreased, at present only 25% of the whole country area remained (ประนอม จันทรโณทัย และ ก่องกานดา ชยามฤต, 2543).

The sustainable utilization of plant natural resource requires the fundamental knowledge of plant diversity. The Flora of Thailand project is being carried out, but only 35% was finished (ประนอม จันทรโณทัย และ ก่องกานดา ชยามฤต, 2543). It was rather a slow process as compared with those of neighbouring Indochina, Malaysia and Indonesia, primarily due to shortage of specialized plant taxonomists. Accordingly, the exploration of plant diversity is still in needs, especially in some remote areas which never been explored botanically.

Huaiyang Waterfall National Park is located at the narrowest point of the country, in Tub Sakae and Bang Saphan District, Prachuap Khiri Khan Province. Geographically speaking, this area is probably the transitional zone from southwestern floristic region to peninsular floristic region. Khao Luang in this area is also interesting for the exploration of ferns and fern allies diversity. Since this mountain is part of Tanao Sri range and Khao Luang is one of the high peaks of this mountain range. From the literature review, it was found that the western floristic region is not frequently investigated into the plant diversity as compared with the other parts of the country. However, some botanical expeditions were made in Kanchaburi Province, but they mainly focused on flowering plants. Therefore, the knowledge on ferns and fern

allies diversity in this floristic region is rather small. Consequently, botanical surveys of ferns and fern allies diversity in this region is necessary to gain more knowledge on species diversity as well as geographical distribution.

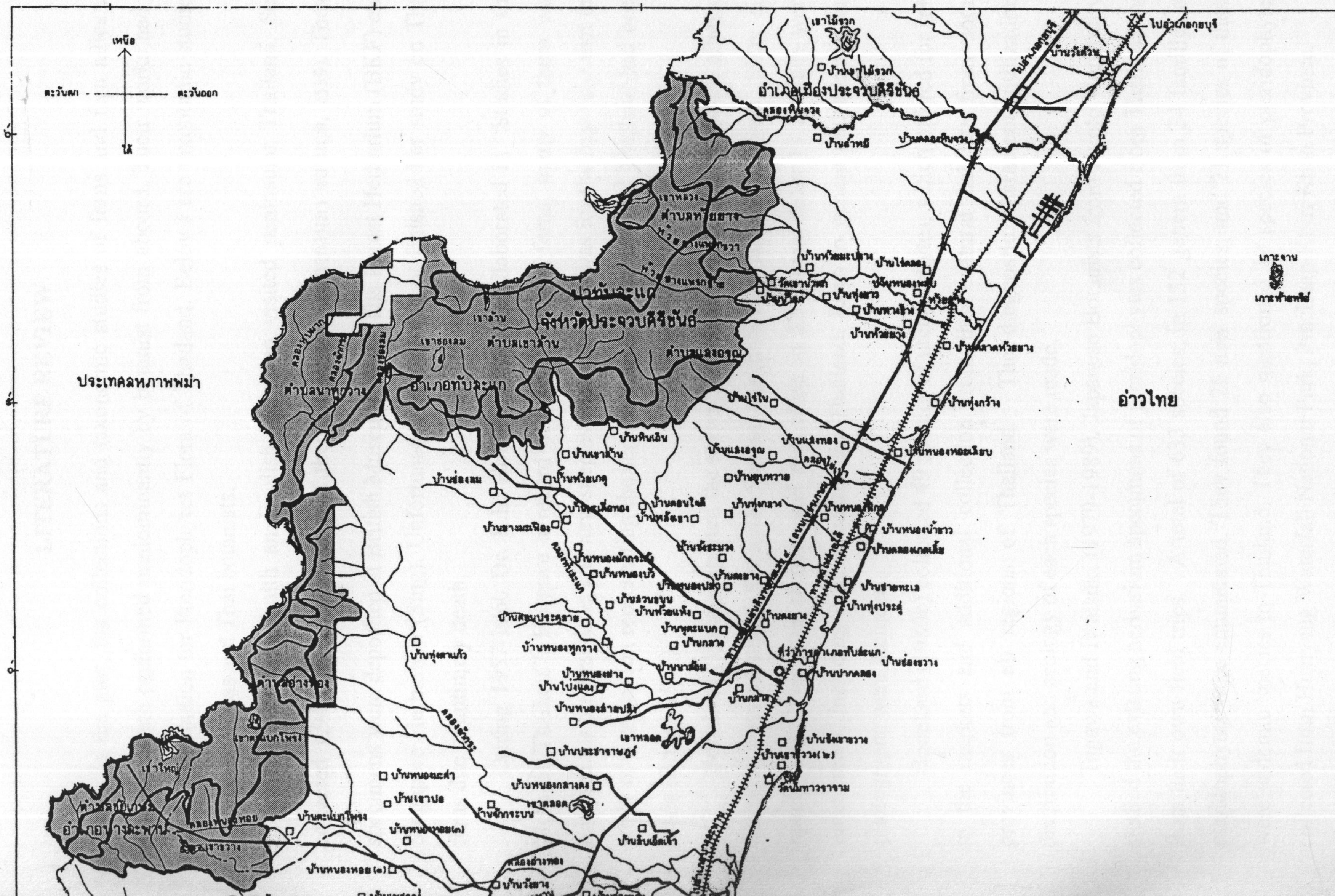
From the literature survey there were a small collection of ferns and fern allies at Huaiyang Waterfall National Park, but only 19 species were observed (Tagawa and Iwatsuki, 1979-1989). Economically, ferns and fern allies are being recognized for their economic importance not only as human consumption for foods and medicines, but also as plant materials in manufacture of handicrafts, condoms, and fireworks. Ferns and fern allies trade for ornamentation plants and collections are worldwide and need to be controlled.

Aims of this Thesis

To conduct a botanical inventory of ferns and fern allies at Huaiyang Waterfall National Park, Prachuap Khiri Khan Province.

Fig. 1.1 Map Showing Location of Huaiyang Waterfall National Park

Ratio 1: 200,000



CHAPTER II

LITERATURE REVIEW

In the past, the collections and taxonomic studies of ferns and fern allies in Thailand were performed predominantly by botanist from aboard. Their works had a great contribution for Pteridophytes Flora of Thailand. Belows are taxonomic studies of some overseas and Thai botanists.

In 1922 Eryl Smith an English physician visited peninsular Thailand. She collected 1,948 specimens, many of them were ferns (ก่องกานดา ชยามฤต, 2539). These specimens were deposited at British Museum (BM), The Forest Herbarium (BKF) and Singapore Herbarium (Sing). Unfortunately she could not finished her study on Thai ferns due to untimely death.

During 1957-1960 Dr. R.E. Holttum of Kew collaborated in "Studies in the Flora of Thailand". He gave a record of 157 species of ferns, many of them was reported for the first time, and new species were found. It was for the first time that the study of a collection representing the fern flora of various parts of Thailand had been made (Bruun, 1961).

Boonkerd (1980a) reported the survey and collection of ferns and fern allies at Sakaerat Environmental Research Station, Nakhon Ratshasima Province. Sixty six species and 2 varieties of ferns and fern allies in 32 genera, from 19 families were enumerated, including 3 new records for Thailand. Keys to genera and species and photographs were included.

Boonkerd (1980b) collected 49 species of pteridophytes, which offered for sale in the markets and additional collection from their natural habitats from some provinces from all regions of Thailand. The diagnostic characters, utilization, distribution and ecology of each species were made.

Tagawa and Iwatsuki (1979-1989), Japanese Botanists from Kyoto University, studied the existing herbarium specimens of pteridophytes collected from Thailand and from their own field trips. A total of 633 species, in 132 genera from 34 families of pteridophytes were enumerated. They found 25 new species, and 21 species of these were endemic species to Thailand. They also mentioned 19 species of pteridophytes collected from Huaiyang Waterfall National Park, Prachuap Khiri Khan Province.

Boonkerd (1981) reported 20 species of medicinal ferns collected from Thailand. The data of medicinal ferns were obtained from local herbalists and some additional collections from their natural habitats. Scientific name, local name, short description, and part uses were prepared.

Thammathawon and Thammathawon (1983) reported the collection of pteridophytes occurred in exposed places at Phu Kradung National Park. They found 19 species in 16 genera of these sun-plants.

In 1986 Sutheera Arkarakraisri studied spore morphology of ferns in Denstaedtiaceae from the specimens collected in Thailand. Her study included 16 species, 2 subspecies, and 4 varieties. Keys to genera, species and varieties were made based on spore morphology from this study.

Thipthabeankan (1989) reported a taxonomic study of *Adiantum* in Thailand. She studied from the existing specimens deposited at BKF, BK and living specimens from the sunday market. She reported 10 native species and 14 species, 19 varieties of introduced plants. Descriptions and keys to genera, species and varieties were prepared.

In 1992-1993 Boonkerd et al. surveyed plant community at Phrachomklao Science Park at Wa-Kor, Prachuap Khiri Khan Province. A total of 184 species in 162 genera from 81 families of vascular plants were enumerated, but only 2 species of ferns were noted.

In 1996-1999 Piyapong Rachata explored the diversity of ferns and fern allies at Khunkorn Forest Park, Chiang Rai Province. A total of 153 species in 56 genera from 24 families were found, including a new record (*Selaginella ciliaris*). Of these, 16 species in 3 genera from 3 families were fern allies.

Recently, Boonkerd and Pollawatn (2000) complied data from various sources as well as from their own field trips. Consequently, a checklist of ferns and fern allies in Thailand was made. A total of 671 species, 4 subspecies, 28 varieties in 139 genera from 35 families were enumerated. This checklist included 27 new records of Thailand.

From the above literature reviews, it can be concluded that survey of pteridophytes in Prachuap Khiri Khan and neighboring provinces was scarced as compared with the flowering plants. In addition, 19 species mentioned in Flora of Thailand by M. Tagawa and K. Iwatsuki (1979-1989) was rather small in number.

Therefore, the botanical surveys of pteridophytes should be made at Huaiyang Waterfall National Park, Prachuap Khiri Khan Province.

CHAPTER III

STUDY SITE

1. Status of Huaiyang Waterfall National Park

Huaiyang waterfall National Park was established in 1971. It is one of the scenic mountainous areas, including an important watershed area. The park consisted of former Tubsakae Forest Park and Huaiyang Forest Park, which included some attractive waterfalls such as Khao Lan Waterfall, Bua Sawan Waterfall, Huai Hin Dad Waterfall, Kha On Waterfall and Huaiyang Waterfall (สุพจน์ พริ้งเพริศ, 2543).

2. Location

Huaiyang Waterfall National Park is located on the south of the narrowest area of Thailand, covers an area of approximately 161 km^2. The park occupied Tumbon Huaiyang, Tumbon Khao Lan, Tumbon Sang Arun, Tumbon Na Hu Kwang and Tumbon Ang Thong in Tubsakae District, and Tumbon Chaikasame in Bang Saphan District, Prachuap Khiri Khan Province. It is marked out approximately by the geographical coordinates of 11° 37'-11° 41' north latitude and 99° 24'-99° 37' east longtitude. It is bounded on the north by Hin Chaung Canal in Tumbon Huaiyang, Tubsakae District; on the south by Morasuap Canal in Tumbon Chaikasame, Bang Saphan District; on the east by Tubsakae Reserve Forest, Tubsakae District and Bang Saphan District; and on the west by Union of Myanmar (สุพจน์ พริ้งเพริศ, 2543).

3. Topography

Huaiyang waterfall National Park is located on Tanao Sri Range, and becoming natural border between Thailand and Union of Myanmar, this border is about 50 km in length. The park ranges in elevations from 100 to 1, 250 m. at the summit of Khao Luang. Most of the park are mountainous areas, plains are observed only in the valley. Generally, the mountain slopes in the park are about 10-30% (สุพจน์ พริ้งเพริศ, 2543). Khao Luang is also located a watershed and streams flow into waterfalls such as Huaiyang Waterfall, Bua Sawan Waterfall.

4. Geography

Geological speaking, Huaiyang Waterfall National Park is mostly composed of granitic rocks and granodiorite, covered an area of 130 km^2 or nearly 81% of the park area. The park is located in Tanao Sri Range, arranged from north to south. Moreover, the area about 7.4 km^2 or about 5% of the park area composed of gniess and schist. Rocks in some area belong to rocks of the Tanao Sri group, such as the Kaeng Krachan Formation. This area is about 14.6 km^2 or approximately 9% of the whole area (สุพจน์ พริ้งเพริศ, 2543).

5. Edaphic Structure

A slope complex composts mainly of composite granite, lime stone and sand stone. It covers an area of 150 km^2, and approximately 93.5% of the whole area. Soil types in this area are soil of the Thungwa alkaline variant and soil of the Khlong Nok Krathung alkaline variant, and soils of the Bang Saphan series (สุพจน์ พริ้งเพริศ, 2543).

6. Climate

The climate of the area is Tropical Savannah Climate, with high temperature all the year round and a period of dry season is distinct. Three seasons were observed. i.e. the rainy season during May-November, the winter season during December-February and the summer season during March-April (Meteorological Department, 1999). Prachuap Khiri Khan Climatic Station in Muang District is the nearest station The climatological data[1] during 1969-1999 shows the average annual temperature of 27.1 ° C. The average maximum temperature was about 33.2 °C during April-May, and the average minimum temperature 19.9 °C in January (Figure 3.4). The average annual relative humidity was about 78%, while the average maximum relative humidity was 89% and the average minimum relative humidity was 63% (Figure 3.3)

The average annual rainfall was 1150 mm. The highest average annual rainfall of approximately 300 mm was observed in October, whilst the lowest annual rainfall of about 28 mm was observed in December (Figure 3.2).

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[1] The climatological data during 1969-1999 is probably rather drier and hotter than the average for the park as a whole.

7. Vegetation

The vegetation at Huaiyang Waterfall National Park may be divided among Mixed Deciduous Forest, Dry Evergreen Forest, Tropical Evergreen Forest and Hill Evergreen Forest (สุพจน์ พริ้งเพริศ, 2543).

7.1 Mixed Deciduous Forest (MDF) covers an area of 49.95 km^2 or approximately 31% of the whole area. It is a Dry Upper Mixed Deciduous Forest ranges in elevation from about 500 to 800 m. with low relative humidity, thin layer of soil on the base rock. Most trees are dwarfed and bamboos are frequently found throughout (สุพจน์ พริ้งเพริศ, 2543).

7.2 Dry Evergreen Forest (DEF) covers an area of 74.92 km^2 or approximately 46% of the whole area. The elevation ranges from 100 to 800 m. Plants grew in this forest were both deciduous and evergreen trees, so the canopy was still green all the year round. In this forest, soil layer is deep and composed mainly of moist sandy loam (สุ พจน์ พริ้งเพริศ, 2543).

7.3 Tropical Evergreen Forest (TEF) covers an area of 32.5 km^2 or approximately 20% of the whole area. The elevation ranges from 800 to 1,000 m. This forest type is composed of medium-to-tall trees which remain almost green during the dry season, and has a closed to slightly open canopy. By and large relative air humidity is rather high, soil layers are deep with high soil humidity (สุพจน์ พริ้งเพริศ, 2543).

7.4 Hill Evergreen Forest (HEF) covers an area of 3.64 km^2 or approximately 2% of the whole area. It is a primary forest near the summit of Khao Luang. The elevation ranges from 1,000 to 1,250 m. Soil in this forest is rather deep, covered by rich humus and high humidity (สุพจน์ พริ้งเพริศ, 2543).

Fig. 3.1 Forest types found at Huaiyang Waterfall National Park

Ratio 1: 200,000

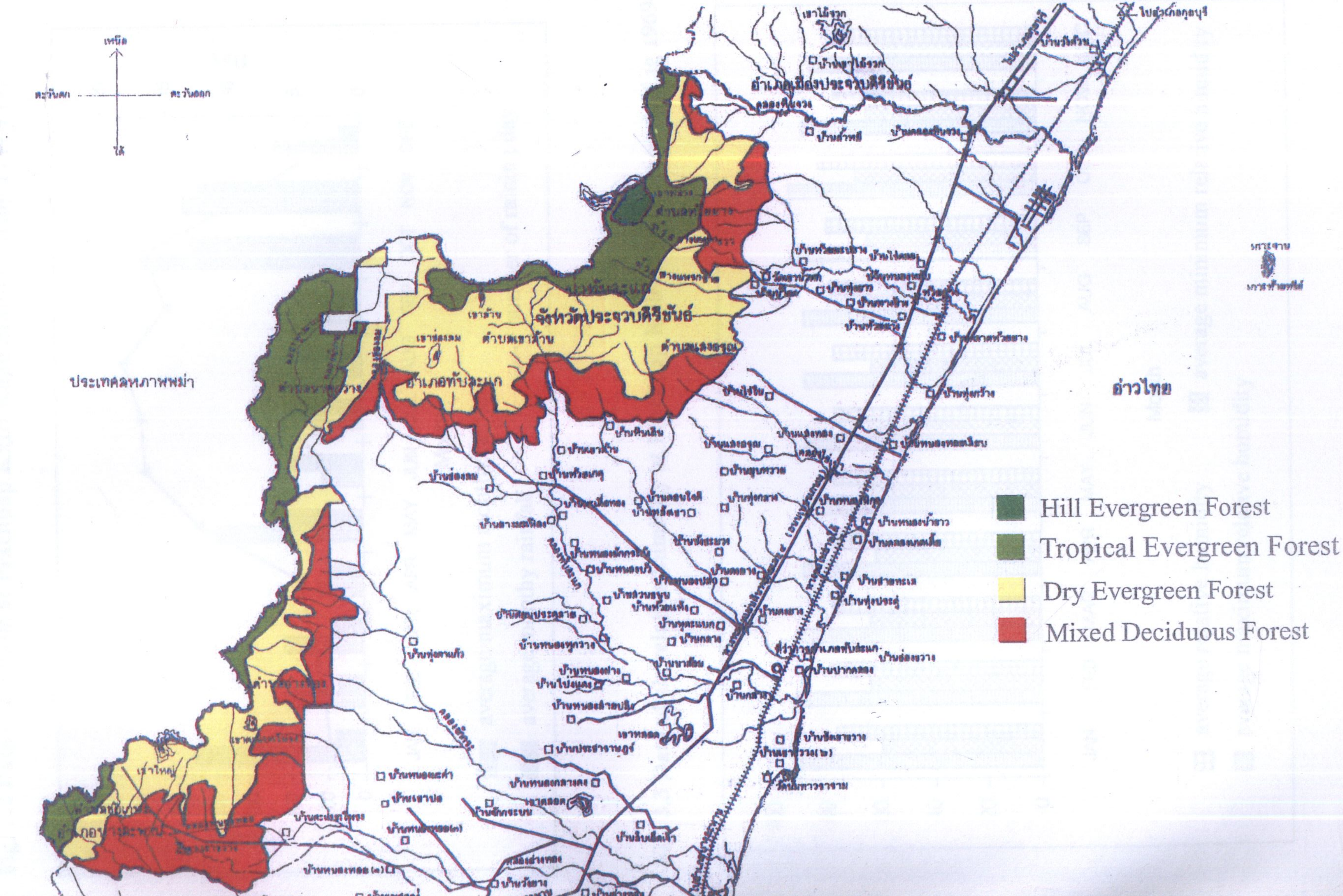


Fig. 3.2 Data of rainfalls at Prachuap Khiri Khan Station during 1969-1999

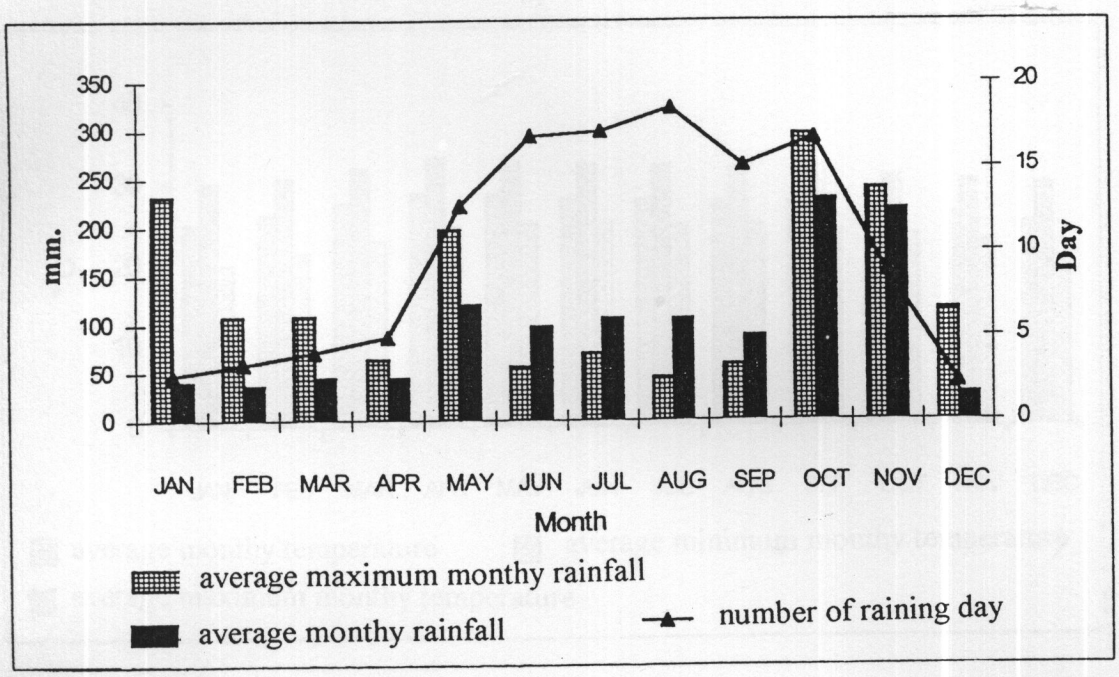


Fig. 3.3 Data of air relative humidity at Prachuap Khiri Khan Station during 1969-1999

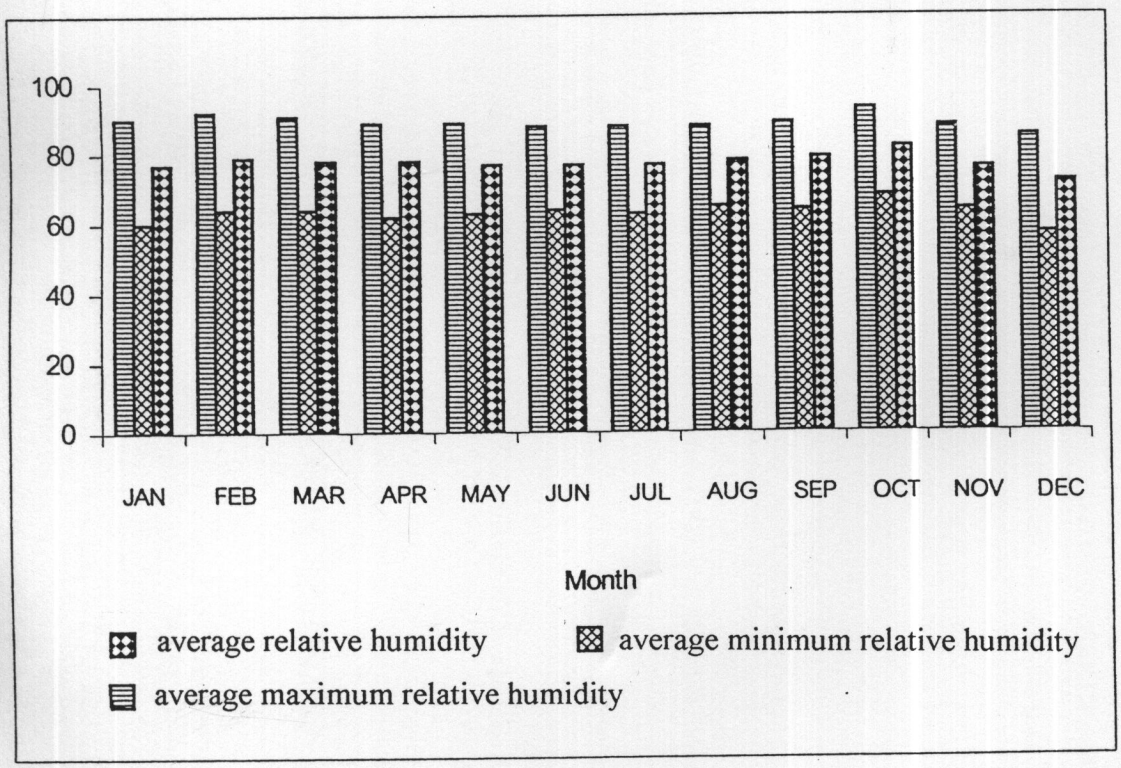
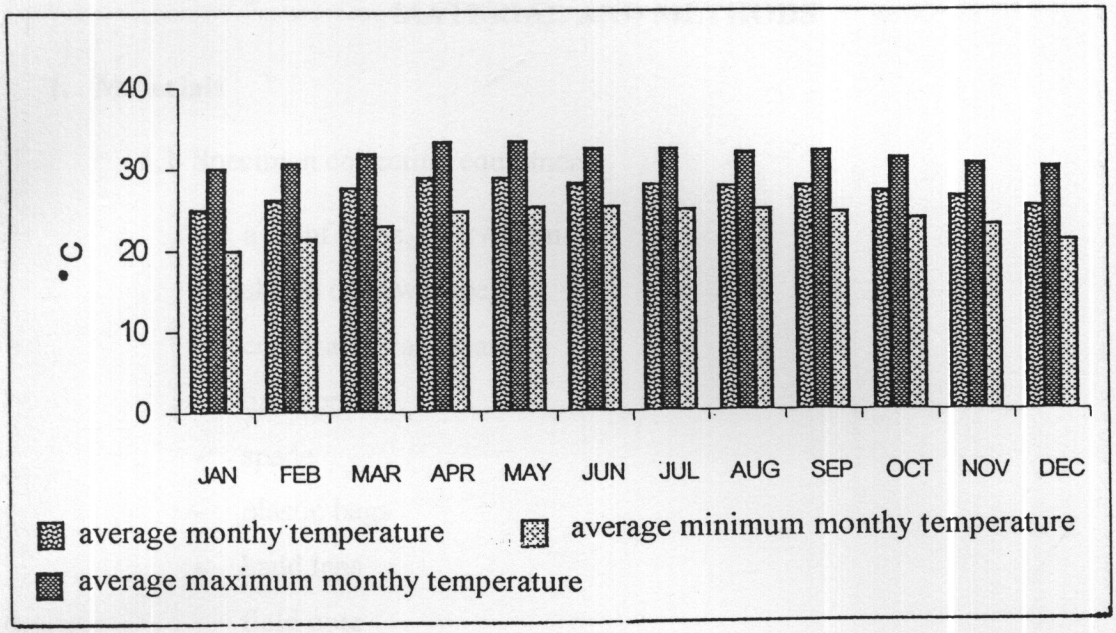


Fig. 3.4 Data of air temperature at Prachuap Khiri Khan Station during 1969-1999



CHAPTER IV

MATERIAL AND METHODS

1. Materials

1.1 Specimen collecting equipments

- a plant press, 30 x 45 cm
- sheets of newspapers
- corrugated cardboard
- hand pruner
- spade
- plastic bags
- hand lens
- field note
- camera
- films (colour print and transparency slide)
- altimeter
- tags

1.2 Herbarium specimen preparing equipments

- Deep freezer (-40 °C)
- Hot air oven
- mounting paper, 30 x 42 cm
- species covers, 30 x 42 cm
- genus covers, 30 x 42 cm
- latex mixed with synthetic glue in ratio 1:1
- label pad, about 10.5 x 13.5 cm
- needle and thread
- sand bags

1.3 Identification equipments

- dissecting microscope
- dissecting needles
- razor blades
- Petri dishes

- Flora of Thailand, Vol. 3 and Related taxonomic literatures

2. Method

2.1 Literature review

- The related literatures were searched from the libraries at the Professor Kasin Suvathabhandu Herbarium, Department of Botany, Chulalongkorn University (BCU) and the Forest Herbarium, Royal Forest Department (BKF).
- The Fundamental data of the studied site such as location, area, boundary, topography, climate, Flora, Transportation and studied site were studied from the park's folders, pior field trip will be made.

2.2 Exploration and collection

- Six duplicates of ferns and fern allies specimens were collected and photography were taken for each species. Plotless method was employed, specimens were gathered along the existing forest trails, extending about 5 m. from both sides. Monthly interval was designed for field trips during March 1999-October 2000. Some moist areas were selected for repeatable visits such as, Huaiyang Waterfall, Bua Sawan Waterfall, Khao Lan Waterfall, Khao Lan peak, Huai Hin Dad Waterfall, Kha On Waterfall, Praksai Canal and the summit of Khao Luang peak.
- Ecological data, habit and some diagnostic characters of each species were noted.

3. Laboratory study

- Dried herbarium specimens were prepared as described in Boonkerd et al. (1987) and deposited at BCU and BKF.
- Both internal and external morphological characters were studied.
- Plant specimens were identified using both keys and descriptions from taxonomic literatures, such as Flora, Manual, Monograph, Research papers, etc. as shown in the references.
- Specimens of each species were proved for identity by comparison to the voucher herbarium specimens deposited at BCU and BKF.

- Nomenclature and arrangement of taxa in this thesis follow Boonkerd and Pollawatn (2000).
- Dichotomous keys to genera and species were constructed for determining each taxon in the studied area.
- Author of scientific names and their abbreviation used in this thesis are in accordance with the author of plant names (Brummitt and Powell, 1992).
- Description of each species was prepared, base solely on specimens collected from Huaiyang Waterfall National Park.
- In addition, other information, including ecological data, distribution, vernacular name for each species, was prepared.

CHAPTER V

RESULTS

Two hundreds and four specimens of fern and fern allies were collected from March 1999 to October 2000. They are classified into 26 families, 57 genera and 126 species (Table 5.1).

Table 5.1 List of the Pteridophytes at Huaiyang Waterfall National Park.

Taxon	Habitat	Vegetation	Frequency
Class Lycopsida			
Order Lycopodiales			
Lycopodiaceae			
Huperzia hamiltonii (Spreng.) Trevis.	E	HEF	SC
Lycopodiella cernua (L.) Pic. Serm.	T	HEF	SC
Class Selaginellopsida			
Order Selaginellales			
Selaginellaceae			
Selaginella amblyphylla Alston	L	HEF	SC
Selaginella argentea (Wall. ex Hook. & Grev.) Spring	T, L	MDF, HEF	C
Selaginella delicatula (Desv.ex Poir.) Alston	T	MDF	SC
Selaginella kurzii Baker	L	MDF	SC
Selaginella minutifolia Spring	L	DEF	C
Selaginella ostenfeldii Hieron	T	MDF	C
Selaginella roxburghii (Hook. & Grev.) Spring	T, L	DEF	C
Selaginella vaginata Spring	T, L	MDF	C

Taxon	Habitat	Vegetation	Frequency
Class Psilotopsida			
Order Psilotales			
Psilotaceae			
Psilotum nudum (L.) Beauv.	L, E	MDF	SC
Class Polypodiopsida			
Order Marattiales			
Marattiaceae			
Angiopteris evecta (G. Forst) Hoffm.	T	MDF, HEF	C
Order Ophioglossaless			
Ophioglossaceae			
Ophioglossum petiolatum Hook.	T	MDF	SC
Order Hymenophyllales			
Hymenophyllaceae			
Crepidomanes bipunctatum (Poir.) Copel.	L, E	DEF, TEF, HEF	VC
Crepidomanes megistostomum (Copel.) Copel.	L	DEF	SC
Crepidomanes minutum (Blume) K. Iwats.	L	TEF	SC
Crepidomanes parvifolium (Baker) K. Iwats.	L	TEF	SC
Hymenophyllum barbatum (Bosch) Baker	E	HEF	UC
Hymenophyllum exsertum Wall. ex Hook.	E	HEF	UC

Taxon	Habitat	Vegetation	Freqeuncy
Order Gleicheniales			
Gleicheniaceae			
Dicranopteris linearis (Burm. f.) Underw. var. *linearis*	T	HEF	SC
Order Schizaeales			
Schizaeaceae			
Lygodium microphyllum (Cav.) R. Br.	T	MDF	SC
Lygodium salicifolium C. Presl	T	MDF	C
Order Dicksoniales			
Dennstaedtiaceae			
Microlepia puberula v. A. v. R.	T	HEF	C
Microlepia speluncae (L.) T. Moore	T	MDF, DEF	C
Microlepia strigosa (Thunb.) C. Presl	T	HEF	VC
Dicksoniaceae			
Cibotium barometz J. Sm.	T	TEF	C
Lindsaeaceae			
Lindsaea divergens Hook. & Grev.	L	MDF	UC
Lindsaea ensifolia Sw.	T	HEF	SC
Sphenomeris chinensis (L.) Maxon var. *divaricata* (H. Christ) K. U. Kramer	T	HEF	SC
Order Cyatheales			
Cyatheaceae			
Cyathea borneensis Copel.	T	DEF	UC
Cyathea latebrosa (C. Presl) Copel.	T	TEF, HEF	UC

Taxon	Habitat	Vegetation	Freqeuncy
Order Pteridales			
Adiantaceae			
Adiantum caudatum L.	T	MDF	C
Adiantum philippense L.	L	MDF	SC
Adiantum zollingeri Mett. ex Kuhn	T	MDF, DEF	C
Doryopteris ludens (Wall. ex Hook.) J. Sm.	T	MDF, DEF	VC
Hemionitis arifolia (Burm. F.) T. Moore	T	MDF	UC
Notholaena velutina Tardieu & C. Chr.	T, L	MDF	C
Pityrogramma calomelanos (L.) Link.	T	MDF	SC
Parkeriaceae			
Ceratopteris thalictroides (L.) Brongn.	A	MDF	UC
Pteridaceae			
Pteris biaurita L.	T	MDF, DEF, TEF, HEF	C
Pteris cretica L.	T	TEF	C
Pteris longipinnula Wall. ex J. Agardh	T	TEF	UC
Pteris venusta Kunze	T, L	MDF	C
Stenochlaena palustris (Burm. f.) Bedd.	T	MDF	VC
Vittariaceae			
Antrophyum callifolium Blume	L	DEF	SC
Vittaria amboinensis Fée	E	HEF	SC
Vittaria ensiformis Sw.	E	DEF	VC
Vittaria sikkimensis Kuhn	L	HEF	SC
Order Blechnales			
Aspleniaceae			
Asplenium cheilosorum Kunze ex Mett.	T, L	HEF	SC

Taxon	Habitat	Vegetation	Frequency
Aspleniaceae (Continued)			
Asplenium confusum Tardieu & Ching	L, E	DEF, TEF, HEF	VC
Asplenium crinicaule Hance	T, L	DEF, TEF, HEF	C
Asplenium falcatum Lam.	L, E	HEF	SC
Asplenium nidus L. var. *nidus*	L, E	DEF, TEF, HEF	VC
Asplenium normale D. Don	T, L	TEF	SC
Asplenium perakense B. Mathew & H. Christ	L, E	HEF	C
Asplenium scortechinii Bedd.	L, E	TEF, HEF	C
Asplenium simonsianum Hook.	E	DEF, TEF	C
Asplenium unilaterale Lam.	T, L	HEF	SC
Asplenium yoshinagae Makino	L, E	HEF	SC
Blechnaceae			
Blechnum orientale L.	T	MDF, HEF	SC
Lomariopsidaceae			
Bolbitis appendiculata (Willd) K. Iwats. Subsp. *Appendiculata*	L	TEF, HEF	C
Bolbitis heteroclita (C. Presl) Ching	E	TEF	C
Bolbitis sinensis (Baker) K. Iwats var. *sinensis*	L, E	HEF	VC
Bolbitis virens (Wall. ex Hook. & Grev.) Schott var. *compacta* Hennipman	T, L	TEF	C
Elaphoglossum subellipticum Rosenst.	E	HEF	C
Dryopteridaceae			
Dryopteris sparsa (D. Don) Kuntze	T	HEF	C

Taxon	Habitat	Vegetation	Frequency
Dryopteridaceae (Continued)			
Heterogonium gurupahense (C. Chr.) Holttum	T	TEF	SC
Polystichum attenuatum Tagawa & K. Iwats.	T	HEF	VC
Polystichum biaristatum (Blume) T. Moore	T	TEF	SC
Pteridrys syrmatica (Willd.) C. Chr. & Ching	T	DEF	C
Tectaria griffithii (Baker) C. Chr.	T	HEF	UC
Tectaria impressa (Fée) Holttum.	T	MDF	C
Tectaria polymorpha (Wall. ex Hook.) Copel.	T	TEF	VC
Thelypteridaceae			
Thelypteris aspera (C. Presl) K. Iwats.	T	TEF	C
Thelypteris dentata (Forssk.) St. John	T	MDF	SC
Thelypteris hirsutipes (Clarke) Ching	T, L	HEF	SC
Thelypteris hirtisora (C. Chr.) K. Iwats.	T	HEF	SC
Thelypteris interrupta (Willd.) K. Iwats.	T	MDF	VC
Thelypteris papilio (Hope) K. Iwats.	T	TEF, HEF	SC
Thelypteris parasitica (L.) Fosberg	T	MDF, DEF	SC
Thelypteris torresiana (Gaud.) Alston	T	DEF	C
Thelypteris triphylla (Sw.) K.Iwats.var. *triphylla*	T	TEF	SC
Thelypterris truncata (Poir.) K. Iwats.	T	DEF, HEF	C
Woodsiaceae			
Diplazium bantamense Blume	T	TEF	C
Diplazium crenatoserratum (Blume) T. Moore	T	TEF	C

Taxon	Habitat	Vegetation	Frequency
Woodsiaceae			
Diplazium dilatatum Blume	T	TEF	VC
Diplazium donianum (Mett.) Tardieu	T	TEF, HEF	VC
Diplazium esculentum (Retz.) Sw.	T	DEF	SC
Diplazium petri Tardieu	T	HEF	C
Diplazium simplicivenium Holttum	T	DEF, TEF	C
Diplazium sp.	T	TEF	SC
Order Davaliales			
Davalliaceae			
Davallia denticulata (Burm. f.) Mett. ex Kuhn	L, E	MDF, DEF	VC
Davallia solida (G. Forst.) Sw.	L, E	MDF, DEF	C
Humata repens (L. f.) J. Small ex Diels	L, E	TEF, HEF	C
Leucostegia immersa C. Presl	T, L	HEF	SC
Oleandraceae			
Nephrolepis biserrata (Sw.) Schott	T	MDF, DEF	SC
Nephrolepis hirsutula (G. Forst.) C. Presl	T	MDF, DEF	VC
Oleandra musifolia (Blume) C. Presl	L, E	HEF	SC
Order Polypodiales			
Polypodiaceae			
Aglaomorpha coronans (Wall. ex Mett.) Copel.	L, E	TEF, HEF	VC
Belvisia mucronata (Fée) Copel.	E	TEF	UC
Belvisia revoluta (Blume) Copel.	E	HEF	C
Colysis pedunculata (Hook. & Grev.) Ching	E	HEF	C

Taxon	Habitat	Vegetation	Frequency
Polypodiaceae (Continued)			
Crypsinus oxylobus (Wall. ex Kunze) Sledge	E	HEF	C
Drynaria bonii H. Christ	L, E	MDF	C
Drynaria quercifolia (L.) J. Sm.	L	MDF, DEF	VC
Drynaria rigidula (Sw.) Bedd.	L, E	MDF, TEF	SC
Lemmaphyllum carnosum (J. Sm. Ex Hook.) C. Presl	L, E	TEF, HEF	C
Lepisorus scolopendrium (Buch.-Ham. Ex D. Don) Mehra & Bir	E	HEF	C
Leptochilus decurrens Blume	T, L	TEF	SC
Leptochiluss macrophyllus (Blume) Noot var. *macrophyllus*	L, E	TEF	SC
Loxogramme avenia (Blume) C. Presl	L	DEF, HEF	SC
Microsorum dilatatum (Bedd.) Sledge	L	HEF	C
Microsorum heterocarpum (Blume) Ching	L	TEF	C
Microsorum nigrescencs (Blume) Copel.	L	DEF	SC
Microsorum pteropus (Blume) Copel.	L	MDF	C
Microsorum punctatum (L.) Copel.	L	MDF, DEF	C
Microsorum zippelii (Blume) Ching	T, L	DEF	SC
Neocheiropteris normalis (D. Don) Tagawa	E	HEF	VC
Platycerium holttumii Jonch. & Hennipman	E	DEF	SC
Polypodium subauriculatum Blume	L, E	DEF, TEF, HEF	VC
Pyrrosia adnascens (Sw.) Ching	L, E	MDF, DEF	VC
Pyrrosia eberhardtii (H. Christ) Ching	L, E	HEF	C

Taxon	Habitat	Vegetation	Frequency
Polypodiaceae (Continued)			
Pyrrosia nuda (Giesenh.) Ching	E	DEF	UC
Pyrrosia stigmosa (Sw.) Ching	L	DEF	VC
Gramitidaceae			
Ctenopteris mollicoma (Nees & Blume) Kunze	L, E	HEF	SC
Grammitis dorsipila (H. Christ) C. Chr. & Tardieu	E	HEF	UC

Note:- E= Epiphyte MDF= Mixed deciduous forest UC= uncommon
A= Aquatic plant DEF= Dry evergreenforest SC= slightly common
L= Lithophyte TRF= Tropical evergreenforest C= common
T= Terrestrial plant HEF= Hill evergreenforest VC= very common

FERNS ALLIES

Devol, Fl. Taiwan Vol. 1. 2nd ed.: 25-57. 1980.

Root and leaves developed or not, plant more or less consistting of dichotomously branched stem and rhizome. Leave microphyllus, univened, and stele without any leaf gap. Sporangia are produced at the lateral side of a stem, in a axial of aleaf or embeded in the base of leaves.

CLASS LYCOPSIDA

Devol, Fl. Taiwan Vol. 1. 2nd ed.: 27. 1980.

Vascular plants rooting at the base, or the rhizomes and stolons bearing adventitious roots. **Stems** erect, creeping, scandent or corm-like; microphyllous leaves with a single central vein. **Sporophylls** arranged in compact strobili or loosely spaced on the stem, sporangia borne in axils of sporophylls or on the base of sporophylls; homosporous or heterosporous.

ORDER LYCOPODIALES

LYCOPODIACEAE

Mirbel, Lamarck and Mirbel, Hist. Nat. Veg. 4. 293. 1802

Terrestrial or epiphytes. **Leaves** simple, with one simple vein, arranged in spiral or irregular whorls, or decussate. **Sporophylls** like the foliage leaves or aggreegate into distinct strobili; sporangia solitary at base of the upper surface of sporophyll; cones distinct or not.

Key to the genera

1. Epiphytic plants; strobilus not distinct; leaves lanceolate **1. Huperzia**
1. Terrestrial plants; strobilus distinct, pendulous; leaves linear **2. Lycopodiella**

1. HUPERZIA

Berh., J. Bot. (Schrader) 1800(2): 1801.- *Lycopodium* L., Sp. Pl.: 1100. 1753.

Stems elongate, dichotomous or sympodial. **Leaves** microphylous, each with a single vein, without ligules arranged in spiral or whorls. **Sporangia** solitary at base of the upper surface of sporophyll; strobilus distinct or not.

Huperzia hamiltonii (Spreng.) Trevis., Atti Soc. Ital. Nat. 17: 248. 1874.- *Lycopodium hamiltonii* Spreng., Syst. Veg. : 429. 1928; Tagawa & K. Iwats., Fl. Thailand 3(1): 9. 1979; Devol, Fl. Taiwan Vol. 1. 2nd ed.: 33. 1980.

Epiphytic plants, **Stems** usually pendulous, 9-10 cm long, sometime dichotomous branching, 1-1.5 mm in diameter near base. **Leaves** ascending or subadnate, lanceolate, acute to acuminate at apex, narrowing towards sessile or very shortly stalked at base, those on middle or lower part largest, about 7-10 mm long by 1-2 mm broad, entire, veins distinct beneath; texture softly chartaceous to thicker, green to yellowish green. **Sporophylls** usually smaller than the tropophylls, about 4-8 mm long by 1-2 mm broad, usually gathered in apical portion, forming no distinct cones, up to 2-4 cm long. **Fig. 6.10**

Thailand.- NORTHERN: Chiang Mai (Doi Chiang Dao, Khun Mae Lan, Khun Kong San, Doi Suthep, Doi Inthanon), Mae Hong Son (Doi Khun Huay Pong), Phitsanulok (Phu Miang); NORTH-EASTERN: Loei (Phu Luang); CENTRAL: Nakhon Nayok (Khao Yai); SOUTH-EASTERN: Chanthaburi (Khao Soi Dao); SOUTH-WESTERN: Kanchanaburi (Sisawat); PENINSULAR: Nakhon Si Thammarat (Khao Luang).

Distribution.- Himalayas (type) to S. China and S. Japan, also in Indo-China and Taiwan.

Ecology.- On mossy tree-trunks usually in Hill evergreen forest at 1050 m altitudes.

Specimens examined.- BCU: Y. Yuyen 97; P. Rachata 182; T. Boonkerd 53, 1255; T. Boonkerd & R. Polwatn 51.

2. LYCOPODIELLA

Holub, C. Preslia 36: 20. 1964.- *Lycopodium* L., Sp. Pl.: 1100. 1750.

Stems of two kinds, creeping and erect, densely covered with leaves, copiously branching. **Leaves** microphylous, each with a single vein. **Strobilus** distinct, cylindrical, pendulous.

Lycopodiella cernua (L.) Pic. Serm., Webbia 23: 166. 1968.- *Lycopodium cernuum* L., Sp. Pl.: 1103. 1753; Tagawa & K. Iwats., Fl. Thailand 3(1): 12. 1979; Devol, Fl. Taiwan vol. 1. 2 nd ed.: 35. pl. 4. 1980.

Terrestrial plants, **Stems** of two kinds, creeping and erect; main erect stem to about 50-60 cm tall, bearing many branches densely covered with leaves, not so dense on lower portion, 3 mm diamiter; lateral branches 2 mm in diamiter, densely covered with leaves, up to 9-12 cm long, copiously branching. **Leaves** linear, pointed at apex, 3 mm long, to 0.2 mm broad, entire, patent and recurved in upper portion; texture thick, yellowish green. **Cones** solitary or two at each apex of the branches, cylindrical, pendulous, 1-1.5 cm long, about 2 mm in diamiter; sporophylls ovoid, acuminate at apex, with minute projection at margin, about 2 by 1 mm, yellowish. **Fig. 6.9**

Thailand.- NORTHERN: Chiang Rai (Doi Tung, Kiu Thap Yang, Mae Lao, Doi Phacho), Chiang Mai (Doi Chiang Dao, Wang Tao, Doi Suthep, Mae Rim), Lampang (Mae Tam), Phitsanulok (Thung Salaeng Luang), Tak (Doi Musoe); NORT-EASTERN: Loei (Phu Kradueng); CENTRAL: Nakhon Nayok (Khao Yai); SOUTH-WESTERN: Kanchanaburi (Wang Ka); PENINSULAR: Chumpon (Bang Son), Surat Thani (Ban Don), Satun (Tarutao), Nakhon Si Thammarat (Thung song, Ron Phibun), Trang (Khao Chong, Thale Song Hong, Sam Roi Yot), Songkhla (Saba Yoi), Narathiwat (Bacho, Nikhom Waeng), Yala (Gunong Ina, Ban To, Padang Besar).

Distribution.- Tropics and Subtropics throughout the world (type from India).

Ecology.- On mountain slopes in open places in Hill evergreen forest at 1050 m altitudes.

Vernacular.- Khut khon (กูดขน) (Northern); Ya kan phiang (หญ้าก้านเพียง), Yaeng yae (แหยงแย้) (North-eastern); Slap (สลาบ), Dok hin (ดอกหิน) (South-eastern); Rang kai (รังไก่), Ruai kai (รวยไก่), Sam roi yot (สามร้อยยอด) (Peninsular).

Specimens examined.- BCU: Y. Yuyen 187; P. Rachata 210; T. Boonkerd 210, 318.

CLASS SELAGINELLOPSIDA

Devol, Fl. Taiwan Vol. 1. 2nd ed.: 42. 1980.

Stems slender, creeping, rooting at the intervals; or erect, usually without branches on lower part, rooting near base. **Leaves** small, simple, with a single vein, always bearing an inconspicuous ligule on the adxial side at its base; vegetative leaves alike or more often dimorphic and usually arranged in two median and two lateral

lateral rows on the branches, the median leaves usually smaller and of a different shape from the lateral leaves; the single axillary leaf borne at the forking of each branch, being somewhat different from the other leaves. **Sporophylls** borne in compact strobili; microsoporophylls with a single microsorangium, which contains a large number of microspores.

ORDER SELAGINELLALES

SELAGINELLACEAE

Devol, Fl. Taiwan Vol. 1. 2nd ed.: 42. 1980.

Stems elongate, bearing leaves and rhizophores, branching dichotomously or pinnately. **Leaves** microphyllous, monomorphic and spirally arranged, or dimorphic arranged in four rows, the ventral two patent or ascending, larger, the dorsal two smaller, appressed to stems, directed distally. **Sporophylls** uniform and arranged spirally forming cylindrical spikes, uniform and arranged in four rows forming squarroid spikes, or dimorphic and arrangement in four rows, the dorsal and ventral rows unequal.

SELAGINELLA

Beauv., Mag. Enc. 4: 478. 1084.

Stems erect or sometimes prostrate or climbing; rhizophore usually present, branching or dichotomously. **Leaves** on aerial, dimorphic or monomorphic. **Sporophylls** uniform and arranged spirally forming cylindrical spikes (strobilus), uniform and arranged in four rows forming squarroid spikes, or dimorphic and arrangement in four rows, the dorsal and ventral rows unequal; strobili solitary or forked.

Key to the species

1. Sporophylls of spikes uniform
   2. Main erect stems dichotomous **7. S. ostenfeldii**
   2. Main erect stems not dichotomous
      3. Ventral leaves at base of main stems distant, erect, appressed
         4. Ventral leaves dentate at apex; 25-40 cm long, bearing rhizophore at base **3. S. delicatula**

4. Ventral leaves ciliate at base; stem in two portion, rhizome and erect stem, 40-50 cm long, rhizophore absent **2. S. argentea**

3. Ventral leaves at base of main stems closed to the next ones or even overlapping spreading

5. Dorsal leaves acuminate at apex; stem bearing rhizophore at base **8. S. vaginata**

5. Dorsal leaves usually long mucronate; stem bearing rhizophore throughout **6. S. roxburgii**

1. Sporophylls of spikes dimorphic

6. Plants larger, 18 cm long; stem prostrate; ventral leaves ciliate near base **1. S. amblyphylla**

6. Plants smaller, 5-10 cm long

7. Main stems bearing rhizophore throughout; dorsal sporophyll elliptic, with long acuminate apex, cuneate at base **5. S. minutifolia**

7. Main stems bearing rhizophore mostly at base; dorsal sporophyll elliptic-subdeltoid, with long tails apex, unequally cordate at base **4. S. kurzii**

1. Selaginella amblyphylla Alston, Bull. Fan. Mém. Inst. Biol. 5: 287. 1934; Tagawa & K. Iwats., Fl. Thailand 3(1): 27. f. 17-19. 1979.

Plants about 10-18 cm long, prostrate, bearing rhizophore throughout. **Main stems** bearing the branches nearly to the base, about 1 mm in diameter not including ventral leaves, main branches oblong to oblanceolate, pinnate-bipinnate; ultimate branches to 4 mm broad including ventral leaves. **Ventral leaves** ascending, patent, oblong-elliptic, acute at apex, unequally cordate at base, about 3 by 1.2 mm those on the main branches, ciliate at least near the base; texture herbaceous, green-yellowish or sometimes reddish. **Dorsal leaves** subdeltoid with long mucronate at apex, cordate at base, ciliate, white margined, about 1.5 by 0.7 mm those on the main branches. **Spikes** about 3 mm broad; ventral sporophylls smaller, oblong-subtriangular directed parallel to the axis, ciliate, white margined; dorsal sporophylls patent or ascending, larger, about 2 mm length. **Fig. 6.11**

Thailand.- NORTHERN: Chiang Rai, Chiang Mai (Doi Chiang Dao, Ban Mae Klang, Doi Suthep, Doi Inthanon-type), Lampang (Mae Mo); NORTH-EASTERN: Loei (Phu Luang, Phu Kradueng); EASTEERN: Nakhon Ratchasima (Khao Yai); SOUTH-EASTERN: Trat (Ko Chang); PENINSULAR: Krabi (Ko Lanta), Satun.

Distribution.- Myanmar and Yunnan.

Ecology.- On mossy rocks in Hill evergreen forest at 1050 m altitudes.

Specimens examined.- BCU: Y. Yuyen 86, 147; BKF: E. Hennipman 3475, 3097; J. F. Maxwell 71-668; G. Murata et al. T16345; Kai Larsen et al. 3357.

2. Selaginella argentea (Wall. ex Hook. & Grev.) Spring, Bull. Acad. Roy. Sci. Brux. 10: 137. 1843; Tagawa & K. Iwats., Fl. Thailand 3(1): 25. 1979.- *Lycopodium argenteum* Wall. ex Hook. & Grev. In Hook., Bot. Misc. 2: 384. 1831.

Stems in two portions, rhizome and erect stems. **Rhizome** suberect or creeping, sparsely bearing pale brown leaves, 2 mm diam., main erect stem 40-45 cm long, bearing more or less appressed uniform leaves in lower portion; lateral branches tripinnate, glabrous; ultimate branches 2 mm in breadth. **Ventral leaves** oblong with falcate upper portion, acute at apex, round to cordate at base, about 2 mm long, 0.5 mm broad; edges minutely ciliate near acroscopic base; texture papyraceous, yellowish green, pale below. **Dorsal leaves** elliptic, aciculate at apex, with distinct white and minutely ciliate at margin, about 1 mm long 0.7 mm broad; ventral leaves on upper portion of stem patent. **Spikes** about 1 mm in diam.; sporophylls ovate-subtriangular with long apex, about 1 mm long 0.5 mm broad, with minute ciliate at edges. **Fig. 6.13**

Thailand.- NORTHERN: Chiang Mai (Fang, Doi Chiang Dao, Doi Suthep), Lampang, Phitsanulok (Thung Salaeng Luang); SOUTH-EASTERN: Trat (Ko Chang); SOUTH-WESTERN: Kanchanaburi (Wang Ka, Kha Thalai), Prachuap Khiri Khan); PENINSULAR: Satun (Nam Tok Boriphat), Trang (Khao Chong).

Distribution.- Myanmar, Malaysia (type from Penang) and Indochina (Laos and Cambodia).

Ecology.- On dry mountain slopes or on rocks in Mixed deciduous forest or in Hill evergreen forest at 180-1050 m altitudes.

Vernacular.- Kapkae (กับแก้), Phokha timia (พ่อค้าตีเมีย) (Northern).

Specimens examined.- BCU: Y. Yuyen 169; BKF: J. F. Maxwell 95-536, M. Tagawa & I. Yamada 1159; Winit 62-931, 1043.

3. Selaginella delicatula (Desv.ex Poir.) Alston, J. Bot. 70: 282. 1932; Tagawa & K. Iwats., Fl. Thailand 3(1): 22. 1979; Devol, Fl. Taiwan vol. 1. 2 nd ed.: 43. 1980.- *Lycopodium delicatulum* Desv. In Lamk., Enc. Suppl. 3: 554. 1841.

Plants to 25-40 cm long, erect or ascending. **Main stems** thick, to 3 mm in diam. near base, bearing rhizophore only on base portion, stramineous, very sparsely bearing leaves, pinnately branching upwards; lateral branches many, pinnate to bipinnate; ultimate branches up to 6 mm broad. **Ventral leaves** patent, oblong-eliptic,

falcate, acuminate to aciculate at apex, unequally base, cuneate at acroscopic base and subcordate at basiscopic base, about 3 by 1 mm, entire margin; texture soft papyraceous, green to yellowish above, paler beneath; **Dorsal leaves** smaller, oblong-elliptic, falcate, mucronate at apex, edges narrowly margined with cartilagineous membrane, entire. **Spikes** up to 12 by 1.5 mm; sporophyll subdeltoid, with long acuminate apex, 1 by 0.5 mm, entire. **Fig. 6.16**

Thailand.- NORTHERN: Chiang Mai (Doi Chiang Dao, Ping Khong, Ban Mae Chia, Doi Suthep, Mae Klang), Mae Hong Son (Mae La Noi); NORTH-EASTERN: Phetchabun (Phu Miang); CENTRAL: Nakhon Nayok (Nang Rong), Saraburi (Muak Lek); SOUTH-EASTERN: Chantaburi (Makham); SOUTH-WESTERN: Kanchanaburi (Sai Yok, Tha Ko); PENINSULAR: Ranong (Khao Thalu), Surat Thani (Ko Tao, Surat), Phangnga (Thap Put), Nakhon Si Thammarat (Khiriwong, Khao Luang), Trang (Khao Chong, Nam Tai), Satun, Yala.

Distribution.- India to S. China and Taiwan, Indochina, Malesia.

Ecology.- Terrestrial on rather dry slopes in light in Mixed deciduous forest shade at 100 m altitudes.

Vernacular.- Kut pha (กูดผา) (Northern); Phak kut hin (ผักกูดหิน) (South-eastern).

Specimens examined.- BCU: Y. Yuyen 157; BKF: C. F. Van Bevsekom et al. 399; J. F. Maxwell 85-59, 94-900, 94-1175, T. Shimizu et al. 20034.

4. <u>Selaginella</u> <u>kurzii</u> Baker, J. Bot. 23: 249. 1885; Tagawa & K. Iwats., Fl. Thailand 3 (1): 30. 1979.

Plants small, about 9-10 cm long, bearing rhizopores mostly at base. **Main stems** about 1 mm in diameter, bearing ventral leaves about 1 mm apart; main branches pinnate to bipinnate; ultimate branches to 2.5 mm broad including ventral leaves. **Ventral leaves** oblong, slightly narrowing towards moderately acute apex, unequally rounded at base, about 2 by 1 mm those on the main branches, patent or ascending; minutely ciliate near the base; texture thin, yellow-green. **Dorsal leaves** elliptic-subdeltoid with long tails, moderately unequale cordate at base, ciliate, about 1.2 by 0.5 mm those on the main branches. **Spikes** about 1.5-2 mm broad; sporophylls dimorphic, oblong-subtriangular with round at base and long acuminate apex, about 2 by 0.7 mm, margin dentate. **Fig. 6.12, 6.15**

Thailand.- NORTHERN: Chiag Rai (Doi Tung), Chiang Mai (Doi Chiang Dao, Doi Suthep, Doi Inthanon, Mae Klang), Lamphun (Doi Khun Tan), Phitsanulok (Thung Salaeng Luang); NORTH-EASTERN: Khon Khaen (Pha Nok Khao); EASTERN: Nakhon Ratchasima (Sikhiu); CENTRAL: Nakhon Nayok (Khao Yai); SOUTH-WESTERN: Kanchanaburi (Plati).

Distribution.- Assam to Myanmar (type) and Malaysia.

Ecology.- On mossy rocks along stream in Mixed deciduous forest at 300 m altitudes.

Specimens examined.- BCU: Y. Yuyen 130; BKF: J. F. Maxwell 94-1092, 97-1351.

5. Selaginella minutifolia Spring, Mém. Acad. Roy. Belg. 24: 239. 1850; Tagawa & K. Iwats., Fl. Thailand 3(1): 28. 1979.

Small plants, about 5-9 mm long. **Main stems** to about 3 mm in diam including ventral leaves, prostrate, bearing rhizophore throughout stem; main branches simple to bipinnate; ultimate branches up to 2 mm wide. **Ventral leaves** patent to ascending, oblong, acute at apex, unequelly round at base, those on main branches about 2 by 0.5 mm; edges distinctly white-margined, dentate; texture thinly herbaceous, yellow-green to reddish. **Dorsal leaves** elliptic with long mucronate at apex, cuneate at base, denticulate and white-margined, about 1 by 0.3 mm those on the main branches. **Spikes** about 2 mm broad; sporophylls dimorphic, ovate-lanceolate, acuminate apex; ventral sporophyll slightly smaller, dentate, white-margined. **Fig. 6.14**

Thailand.- NORTHERN: Chiang Mai (Doi Phahom Phok, Doi Chiang Dao, Doi Suthep), Phitsanulok (Thung Salaeng Luang); PENINSULAR: Ranong (La-un), Trang (Khao Chong).

Distribution.- Myanmar (type), Malaysia, and Indochina (Cambodia & Cochinchina).

Ecology.- On rock in light shade in Dry evergreenforest at 100-160 m altitudes.

Vernacular.- Kut yi (กูดยี) (Northern).

Specimens examined.- BCU: Y. Yuyen 124, 126; BKF: K. Larsen et al. 42472; M. Tagawa T3953; Tatemishimizu et al. T21865.

6. Selaginella ostenfeldii Hieron, Bull. Herb. Boiss. 2. 5: 721. 1905; Tagawa & K. Iwats., Fl. Thailand 3(1): 16. 1979.- *Selaginella pungentifolia* v. A. v. Ros., Bull. Jard. Bot. Buit. 2. 1: 20. 1911.

Rhizome creeping, about 2 mm diam., densely covered with scaly leaves; leaves on rhizome pale brown to pink in young part, oblong, acute at apex, frimbriate at margin; main stem erect, forked at 14-17 cm above rhizome, 1-2 mm in diamiter near base, sparsely bearing the leaves, stramineous, glabrous; both branches of the forked stem pinnate; main lateral branches tripinnate to quadripinnate, the ultimate branches 1 cm long, 1.5 mm broad. **Ventral leaves** patent or ascending, oblong-subquadrangular, falcate acute at apex, sessile, 1.5-2 mm long, 0.5-0.8 mm broad; margin more or less involute, bearing setae at margin; texture soft herbaceous, green to deep green. **Dorsal** leaves narrowly ovate, acuminate at apex, cuneate to cordate at base, ciliate at margin, to 2 mm long 0.5 mm broad on main lateral branches. **Spikes** about 1.2 mm in diam.; sporophylls broadly ovate with long acuminate apex, densely ciliate, 1 mm long 0.8 mm broad. **Fig. 6.18**

Thailand.- NORTHERN: Chiang Mai (Doi Inthanon, Doi Suthep, Mae Klang, Ban Klang, Mae Lan, Bo Luang), Mae Hong Son (Mae La Noi), Lampang (Doi Phalat, Huay Thak, Mae Ngao, Mae Mo), Lumphun (Doi Khun Tan), Phare (Mae Ban), Tak (Lan Sang, Rahaeng, Wang Chao-type), Nakhon Sawan (Ban Takhli); NORTH-EASTERN: Loei (Phu Kradueng); SOUTH-WESTERN: Kanchanaburi (Khao Tong), Prachuap Khiri Khan (Khao Nam Tok, Hua Hin, Tap Sakae); PENINSULAR: Surat Thani (Khao Pak Chong).

Distribution.- Myanmar (Shan State and Moulmein) and Indochina.

Ecology.- Terrestrial on rather dry slope in Mixed deciduous forest at 120-1050 m altitudes.

Vernacular.- Phak khwa (ผักควา) (Northern); Moi sao kae (มอยสาวแก่) (North-eastern).

Specimens examined.- BCU: Y. Yuyen 24; BKF: H. M. Burkill 1271, 1248.

7. Selaginella roxburghii (Hook. & Grev.) Spring, Bull. Acad. Roy. Sci. Brux. 10: 288. 1843; Tagawa & K. Iwats., Fl. Thailand 3(1): 25. 1979.- *Lycopodium roxburghii* Hook. & Grev. In Hook., Bot. Misc. 2: 390. 1831.- *Selaginella* sp.; Tagawa & K. Iwats., Southeast As. St. 3(3): 71. 1965.

Plants subprostrate, to 20-25 cm long. **Main stems** to about 1-1.5 mm in diameter, bearing pale brown leaves rather remotely near the base, stramineous, branching subdichotomously or pinnately, bearing rhizophores usually in lower part; lateral branches bipinnate, ultimate branches 2 cm long, 5 mm wide. **Ventral leaves** oblong, slightly ascending and falcate, acute at apex, cordate at acroscopic and cuneate at basiscopic bases, 4 mm long, 2 mm broad those on mainbranches; edges minutely dentate at apex and acroscopic side; texture herbaceous, greenish to yellowish, pale beneath. **Dorsal leaves** ovate-subdeltoid, round to subcordate at base, long mucronate at apex, to 1.5 mm long, those on the main branches 1 mm broad, imbricate, edge dentate. **Spikes** one or two on altimate branch, about 4 mm long, 1.5 mm broad at base; sporophylls ovate-subdeltoid, gradually narrowing towards acuminate apex dentate margin, about 2 mm long, 0.7 mm broad. **Fig. 6.17**

Thailand.- NORTHERN: Chiang Mai (Fang, Doi Chiang Dao, Doi Suthep, Mae Klang); NORTH-EASTERN: Loei (Phu Kradueng); CENTRAL: Nakhon Nayok (Khao Yai); SOUTH-EASTERN: Trat (Ko Chang); PENINSULAR: Nakhon Si Thammarat (Khao Luang), Naratiwat (Sungai Padi).

Distribution.- Malaysia (type) and Sumatra.

Ecology.- Terrestrial on rather dry mountain slopes in Dry evergreen forest at 160 m altitudes.

Specimens examined.- BCU: Y. Yuyen 161, 164; BKF: G. Murata et al. 51774.

8. Selaginella vaginata Spring, Mém. Acad. Roy. Sci.Belg. 24: 87. 1850; Tagawa & K. Iwats., Fl. Thailand 3(1): 23. 1979.

Stems procumbent, bearing rhizophores mostly at base or sometimes throughout, 1 mm in diam. excluding ventral leaves; leaves densed on the stem throughout, dimorphic. **Ventral leaves** oblong-ovate, moderately acute at apex, unequally cordate at base, long ciliate at base, dentate or ciliolate at apical half, distinctly white-margined, 2-3 mm long, 1 mm broad, often curled up and embranching the stems; texture soft papyraceous, green or reddish in open area. **Dorsal leaves** narrowly ovate-oblong, long acuminate at apex, ciliate and white-margined at margin, 1.5 mm long including the aristae of about 0.5 mm in length, to 0.7 mm broad, in main stem. **Spikes** 1.5 mm in diamiter; sporophylls uniform,

subtriangular, long acuminate at apex, about 2 by 0.8 mm, ciliate and white margin. **Fig. 6.19**

Thailand.- NORTHERN: Chiang Mai (Doi Chiang Dao).

Distribution.- N. India (type) to Myanmar.

Ecology.- On mountain slopes or muddy rocks in open to light shade in Mixed deciduous forest at 70-130 m. altitudes.

Specimens examined.- BCU: Y. Yuyen 158, 168; BKF: Gen. Murata et al. T15235; K. Larsen et al. 1135.

CLASS PSILOTOPSIDA

Devol, Fl. Taiwan Vol. 1. 2nd ed.: 25. 1980.

Vascular plants without roots, aerial stems dichotomously forking. **Leaves** minute, scale-like without a midrib, or microphyllous and with a midrib; sporangia brone in axils of leves, 2-3 lobed, eusporangiate, homosporous.

ORDER PSILOTALES

PSILOTACEAE

Devol, Fl. Taiwan Vol. 1. 2nd ed.: 25. 1980.

Stems consisting of rhizomes and aerial stems, dichotomously branching, without roots or leaves. **Synangia** consisting of three sporangia.

PSILOTUM

Sw., Syn. Fil.: 117. 1806.

Stems consisting of rhizomes and areial stems, both branching dichotomously, without roots or leaves; aerial stems bearing scaly projections. **Synangia** consisting of three sporangia, borne on ridges of branches and bearing forked scaly projection at base.

Psilotum nudum (L.) Beauv., Prod. Aetheog.: 112. 1805; Tagawa & K. Iwats., Fl. Thailand 3(1): 5. 1979; Devol, Fl. Taiwan vol. 1. 2 nd ed.: 25. 1980.- *Lycopodium nudum* L., Sp. Pl.: 1100. 1753.- *Psilotum triquetrum* Sw., Syn. Fil.: 117. 1806.

Rhizome short creeping, dichotomously branching at irregular interval, about 1.5-2 mm in diameter, densely covered with brown to dark brown rhizoids. **Areial stems** fasciculate, erect, patent or pendulous, about 25-40 cm in height, deep green, glabrous, dichotomous branching several time in upper portion, grooved, with several distinct ridges 2 mm in diameter. **Scaly projections** small up to 2 by 0.5 mm, oval with subulate at apex, irregular and sparsely borne on ridges. **Synangia** borne adaxially to the projections, glabrous, about 2 mm in diameter, green at young, yellow when mature, caducous. **Fig. 6.20**

Thailand.- NORTHERN: Chiang Rai, Chiang Mai (Mae Rim, Doi Inthanon, Om Koi), Tak (Lan Sang); NORTH-EASTERN: Loei (Wang Saphung), Khon Kaen (Phu Wieng); CENTRAL: Nakhon Nayok (Khao Yai); SOUTH-EASTERN: Chon Buri (Si Racha), Chanthaburi (Pong Nam Ron, Soi Dao); SOUTH-WESTERN: Kanchanaburi (Ban Kaeng Liang), Prachuap Khiri Khan (Huai Yang); PENINSULAR: Chumphon (Ko Wieng, Bang Son), Surat Thani (Ko Pha-ngan), Nakhon Si Thammarat (Kaho Luang).

Distribution.- Tropics and subtropics throughout the world (type from India).

Ecology.- Epiphyte on humus rich tre trunks or on muddy cleft rocks in Dry evergreen forest at 340 m altitudes.

Specimens examined.- BCU: Y. Yuyen 8, 113; K. Sridith 16; T. Boonkerd 1320.

CLASS POLYPODIOPSIDA

Devol, Fl. Taiwan Vol. 1. 2nd ed.: 58. 1980.

Vascular plants ranging from minute epiphytes, small aquatics, common woodland fern to tropical tree ferns; the stems have a wide range of stele types; the leaves differ in size, shape, texture, venation and dermal appendages; the sporangia differ in form and location, usually being borne on the margin or back of ordinary fronds, but are sometime borne on separate fertile fronds; indusia may be present or absent, and if present, of many different shapes; spores occure in a tremendous number of forms, neary all are homosporous, but a few aquatics are heterosporous.

ORDER MARATTIALES

MARATTIACEAE

Holttum, Rev. Fl. Malaya 2: 43. 1955.

Rhizome short and erect, or creeping. **Lamina** bipinnate with free veins or palmately devided with 5 leaflets and anastomosing veins. **Stipes** fleshy with a pair of stipules at the base. **Sporangia** large, opening by a slit, closed together in elongate groups or joined laterally in small circular groups.

ANGIOPTERIS

Hoffm., Comm. Soc. Reg. Gott. 12: 29. 1796.

Rhizome short, massive. **Lamina** bipinnate; pinnae and pinnules swollen at base; veins all free. **Sori** with the close rows of sporangia; sporangia dehiscing along slits on the side of facing the veins.

Angiopteris evecta (G. Forst) Hoffm., Com. Reg. Gott. 12: 29. t. 5. 1796; Holttum, Rev. Fl. Malaya 2: 44. f. 3. 1955; Bedd., Handb.: 460. f. 285. 1969; Tagawa & K. Iwats., Fl. Thailand 3(1): 41. 1979.- *Polypodium evectum* Fosrt., Fl. Ins. Austr. Prod.: 81. 1786.- *Angiopteris crassipes* Wall. ex C. Presl, Suppl. Tent. Pterid.: 23. 1845.- *Angiopteris helferiana* C. Presl, Suppl. Tent. Pterid.: 22. 1845.- *Angiopteris* sp. ; C. Chr., Contr. U. S. Natn. Herb. 26: 329. 1931.

Rhizome short, erects, massive, bearing a tufted of fronds. **Stipes** smooth, fleshy, greens with scattered whitish streak, about 120 cm or more long. **Lamina** bipinnate, various in size; commonly about 200 cm long and to 180 cm wide; rachis green, fleshy, glabrous; pinnae to 90 cm or more long, bearing pinnules 2.5-3 cm apart; pinnules about 15 by 2 cm, oblong-lanceolate, long acuminate apex, each with short swollen fleshy stalk, base unequal, the basiscopic side usually rounded and approaching the rachis a little nearer than the more cuneate acroscopic side, edges parallel for most of their length, with small blunt tooth to each vein-ending, more strongly toothed at apex; texture subcoriaceous, green, pale below, glabrous, some time grooved along sporangia line in the upper surface; veins simple or forked, nearly at the right angles to costa, raised on both surface; recurrent veins slender, usually not

distinct much beyond the sori, indistinct darker line. **Sori** about 1 mm from the edge, usually about 7-22 sporangia. **Fig. 6.22, 6.23**

Thailand.- This is a common species throughout Thailand usually in shade.

Distribution.- Malesia and Indonesia.

Ecology.- Terrestrial along stream in Tropical evergreen forest, or in Hill evergreen forest at 800-1050 m altitudes.

Vernacular.- Wan kip ma (ว่านกีบม้า), Wan kip raet (ว่านกีบแรต) (Central); Kip ma lom (กีบม้าลม), Kip raet (กีบแรต) (Northern); Dugu (ดูกู) (Malay/Peninsular).

Uses.- Rhizome used in local medicine.

Specimens examined.- BCU: Y. Yuyen 42, 200; T. Boonkerd 190, 194, 199, 614, 1252; T. Seelanan 13.

ORDER OPHIOGLOSSALES

OPHIOGLOSSACEAE

Holttum, Rev. Fl. Malaya 2: 38. 1955.

Rhizome subterranean, shorts, erect or creeping. **Lamina** simple or variously divided. **Sporangia** large, born on a simple or branched and usually erect stalked spike attached near the base of the blade.

OPHIOGLOSSUM

L., Sp. Pl.: 1062. 1753.

Rhizome short, erect; trophophyll simple or forked a few times near the apex; venation reticulate. **Spikes** simple, with two rows of sporangia which are fused together almost completely, each opening by transverse slit.

Ophioglossum petiolatum Hook., Exot. Fl. 1. t. 56. 1823; Tagawa & K. Iwats., Fl. Thailand 3(1): 37. 1979; Devol, Fl. Taiwan vol. 1. 2 nd ed.: 70. pl. 19. 1980.- *Ophioglossum reticulatum* auct. non L.: Bedd., Handb.: 465. f. 290. 1969.

Rhizome cylindrical, 4 mm diam., to 8 mm long, bearing many roots. **Lamina** simple, 8 cm long, 1 or 2 on a rhizome; phyllomophore to 4 cm long, yellowish; trophophyll deltoid-ovate, round to moderate acute at apex, deeply cordate at base, 3

cm long, 2.5 cm broad at base; costae not differentiated; veins reticulate, areoles visible, many, free included veinlets often present, simple or branched; texture softy herbaceous, rather fleshy, greenish in living and yelowish in dried specimen, glabrous; sporophyll simple, with stalked of 10-14 cm in length; **Spikes** 2-4 cm long, sporangia up to 1 mm in diameter. **Fig. 6.21**

Thailand.- NORTHERN: Chiang Rai (Doi Tung), Chiang Mai (Doi Phahom Pok, Doi Chiang Dao, Doi Suthep), Mae Hong Son, Lampang (Ngao), Kamphaeng Phet; NORTH-EASTERN: Loei (Phu Kradueng); CENTRAL: Krung Thep; SOUTH-EASTERN: Chanthaburi (Khao Soi Dao, Pong Namron); SOUTH-WESTERN: Kanchanaburi (Hindat); PENINSULAR: Surat Thani (Ban Don).

Distribution.- Pantropic.

Ecology.- Terrestrial on mountain slopes in light shade in Mixed deciduous forest at 400 m altitudes.

Specimens examined.- BCU: Y. Yuyen 172; P. Rachata 198; T. Boonkerd 1017, 1212.

ORDER HYMENOPHYLLALES

HYMENOPHYLLACEAE

Holttum, Rev. Fl. Malaya 2: 72. 1955.

Rhizome usually slender and long creeping with distant fronds, young parts covered with hairs, sometime rootless. **Lamina** variable in shape and size; texture membranous except at veins. **Sori** terminal on the ultimate one-veined lobes, or marginal at vein-ending on leaflets with many veins; receptacle columnar, more or less elongate, the apical part of the indusium more or less dilated, often more or less deeply divided in to two lips.

Key to the genera

1. Involucre bivalvate throughout or to the middle; receptacle included; false veinlets absent **2. Hymenophyllum**
1. Involucre tubular with a truncate or dilated apex; receptacles long extruded false veinlets present or not **1. Crepidomanes**

1. CREPIDOMANES

C. Presl, Epim.: 258. 1849.

Rhizome long-creeping, filiform, hairy. **Lamina** tiny and digitate to medium sized and pinnately compound; false veinlets present or not; involucre obconic to campanulate, winged with bilabiate mouth; receptacles extruded.

Key to the species

1. False veinlets wanting; axes proliferous **3. C. minutum**
1. False veinlets present; axes not proliferous
   2. Fronds simple, or dichotomous on pinnatifid
      3. Involucre bilabiate mouth; fronds oblong-lanceolate or dichotomous on pinnatifid, about 6 mm long **4. C. parvifolium**
      3. Involucre dilated mouth; fronds flabellate, about 2-3 cm long **2. C. megistostomum**
   2. Fronds tripinnatifid, about 4-6 cm long **1. C. bipunctatum**

1. Crepidomanes bipunctatum (Poir.) Copel., Phil.; K. Iwats., J. Fac. Sci. U. Tokyo III. 13: 536. 1985.- *C. bilabiatum* (Nees & Bl.) Copel.; Tagawa & Iwats., Fl. Thailand 3(1): 90. 1979.

Rhizome long-creeping, slender, about 1 mm diam., covered with short dark brownish hairs. **Stipes** about 1.5-3 cm long, winged almost to the base, bearing short hairs, blackish; rachis winged throughout. **Lamina** variable in shape and size, deltoid ovate to oblong, acute at apex, tripinnatifid, usually 4-6 cm long, 3.5-4.5 cm wide, pinnae 6-8 pairs, the big ones 2-2.5 cm long, 1 cm wide, shortly stalked or sessile in the upper ones; pinnule oblong, oblique, with about 6-9 segments; ultimate segment linear, at a narrow angle to each other, acute to round at apex, entire and flat at margin; false veinlets marginal, continuous, occupying two row of marginal cell; texture herbaceous, light green, glabous. **Sori** on the apices at short axillary lobes; involucre tubular 2 mm long, winged, mouth bilabiate, the lips acute as wide as long. **Fig. 6.24**

Thailand.- NORTH-EASTERN: Loei (Phu Kradueng); CENTRAL: Nakhon Nayok (Khao Yai); EASTERN: Nakhon Ratchasima (Pak Thong Chai, Kathok, Ban Tha Kum), SOUTH-EASTERN: Chanthaburi (Taruang, Khao Sabap, Makham, Phriu waterfall), Trat (Ko Chang, Dan Chumpun, Ko Kut); SOUTH-WESTERN: Kanchanaburi (Khlong Wa); PENINSULAR: Krabi (Phanom Bencha), Chumphon (Hong Dong), Surat Thani (Khlong Nan Wing, Ban Kop Kape, Ko Tao, Ban Don),

Nakhon Si Thammarat (Khao Luang, Ao Lok), Phuket (Ko Talibong, Thaluang), Phatthalung (Khlong Hin Khao), Trang (Khao Chong), Sa Tun (Khuan Kalong, Nam Tok Boripat, Thung Nui), Narathiwat(Sg.Padi), Yala (Khao Kalakhiri, Bannang Sta, Muang Wing).

Distribution.- Old world tropics (type from Madagascar).

Ecology. - On mossy or muddy rocks or on mossy tree trunks in Dry evergreen forest or Tropical evergreen forest to Hill evergreen forest at 70-1050 m altitudes.

Specimen examined. - BCU: Y. Yuyen 74, 145, 166; T. Boonkerd 40, 77, 79, 236.

2. Crepidomanes megistostomum (Copel.) Copel., Phil. J. Sci. 67: 60. 1938; Tagawa& Iwats., Fl. Thailand 3(1): 88. 1979.- *Trichomanes megistostomum* Copel., Phil. J. Sci. 51.: 191. pl. 23. f. 4-6. 1933.

Rhizome wide-creeping, filiform with numerous brownish hairs, about 0.2 mm diam. **Stipes** short, winged upper part, castaneous, bearing short brownish hairs at base. **Lamina** simple, almost flabellate in appearance, rounded to acute at apex, cuneate at base, base decurrent to rachis, continuing to upper part of stipes, up to 2-2.5 cm long including stipes, 9-13 mm wide, margin lobed mostly to one-third way to costa, oblong to linear oblong, obtuse at apex, about 1 mm in breadth; texture herbaceous, green; false veinlets short, oblique between costa and margin of segment. **Sori** solitary, terminal on ultimate segment, extruded on narrow constriction, involucre tubular and dilated mouth, about 2 mm long; mouth about 1 mm in diam. **Fig. 6.28**

Thailand.- NORTHERN: Phitsanulok (Thung Salaeng Luang); PENINSULAR: Phangnga (type).

Distribution.- Endemic.

Ecology.- On wet rocks in Dry evergreen forest at 70 m altitudes.

Specimen examined.- BCU: Y. Yuyen 167; BKF: B. Hansen et al. 12383; J. F. Maxwell 95-787.

3. Crepidomanes minutum (Blume) K. Iwats., J. Fac. Sci. U. Tokyo III. 13: 524. 1985.- *Gonocormus teysmanni* van der Bosch, Hymen. Jav.: 10. pl. 5. 1861.- *Gonocormus saxifragoides* (C. Presl) van den Bosch; Tagawa & K. Iwats., Fl. Thailand 3(1): 80. 1979.- *G. prolifer* (Bl.) Prantl; Tagawa & K. Iwats., 1. c. 81. 1979.- *G. siamensis* Tagawa & K. Iwats.; Tagawa & K. Iwats., 1. c. 81. 1979.

Rhizome long-creeping, slender, sparsely with dark brown hairs. **Stipes** slender, wingless, glabrescent, about 1-2 cm long, dark, sparsely hairy throughout. **Lamina** flabellate to oblong, usually pinnate, up to 2-2.5 by 1-1.5 cm; rachis proliferous; ultimate segment linear, round to moderate acute at apex, more less recurved at margin; segments of frond without false veins; texture membranous, pale green. **Sori** sunk at apices of segments; involucre tubular, winged, mouth dilated. **Fig. 6.25**

Thailand.- NORTH-EASTERN: Loei(Phu Luang); EASTERN: Nakhon Ratchasima (Khao Lotung); SOUTH-EASTERN: Prachin Buri (Khao Yai), Trat (Ko Kut); SOUTH-WESTERN: Prachaup Khirikhan (Khao Luang); PENINSULAR: Krabi (Ko Pu), Ranong (Khao Photachongdong), Nakhon Si Thammarat (Khao Luang), Trang (Chao Sung, Khao Chong), Narathiwat (Bacho Falls), Yala (Khao Kalakhiri, Betong).

Distribution.- Throughout Malesia (type from Java).

Ecology.- On wet mossy rocks near streams in Tropical evergreen forest at 900 m altitudes.

Specimen Examimed.- BCU: Y. Yuyen 179; BKF: E. Hennipman 36678; M. Tagawa et al. 2015, 4688, 6813.

4. Crepidomanes parvifolium (Baker) K. Iwats., J. Fac. Sci. U. Tokyo III. 13: 535. 1985. - *Microgonium parvifolium* (Bak.) Tagawa & K. Iwars., Fl. Thailand 3(1): 93. 1979.

Rhizome filiform, densely covered with browish hairs throughout. **Stipes** terrete, 1-1.5 mm long, slender than rhizome, glabrous or with caducous hairs like those on rhizome, green-narrowly winged in the upper part. **Lamina** small, to 6 mm long including stipes, simple and oblong-lanceolate, or dichotomous on pinnatifid, simple lamina or ultimate segmants oblong-lancelate, round at apex, margin entire, 3-3 mm long, 1 mm broad, with a simple distinct veins; pseudo-veinlets several on a segment, oblique; texture thin, deep green. **Sori** solitary, terminal on ultimate segment, involucre obconic, tubular, 0.8-1 mm long; mouth bilabiate, about 0.5-1 mm long, subtriangular, moderately acute at apex. **Fig. 6.29**

Thailand.- SOUTH-EASTERN: Chanthaburi (Khao Soi Dao); PENINSU LAR: Trang (Khao Chong).

Distribution.- Myanmar (Moumien-type).

Ecology.- On damp rocks in moist places in Tropical evergreen forest at 800 m altitudes.

Specimen examine.- BCU: Y. Yuyen 132, 180; BKF: E. Hennipman 3900; M. Tagawa et al. 6498.

2. HYMENOPHYLLUM

J. E. Smith, Mém. Acad. Turin. 5: 418. 1793.

Rhizome filamentous, generally not distinctly different from stipes and rachis, all axes typically proliferous. **Lamina** small, flabellate or pinnate; false veinlets absent; involucre elongate, mouth dilated, entire; receptacles extruded.

Key to the species

1. Margin of lips entire **2. H. exsertum**
1. Margin of lips serrate **1. H. barbatum**

1. Hymenophyllum barbatum (Bosch) Baker, Syn. Fil.: 68. 1867; Tagawa & K. Iwasts., Fl. Thailand 3 (1): 74. 1979; Devol, Fl. Taiwan vol. 1. 2 nd ed.: 120. 1980.- *Leptocionium barbatum* van den Bosch, Ned. Kruid. Arch. 5(2): 146. 1863.

Rhizome filiform, long-creeping, covered with sparsely brownish hairs throughout. **Stipes** 1-1.3 cm apart, narrowly winged in the upper part, rather densely hairy, 0.6 – 2 cm long, dark purple. **Lamina** bipinnatifid, oblong to oblong-lanceolate, moderately acute at apex, acute at base, 2.5 cm long, 2 cm wide; rachis distinctly winged, rather densely hairy on the lower side; pinnae oblong, round to acute at apex, unequaully cuneate at base, the largest 1 cm long and 0.5 cm wide; ultimate segments linear-oblong, usually about 1 mm wide, distinct toothed and crisped at margin like the wings of the rachis; every axis rather distinct, purple, hairy on the under side; texture thin, deep green. **Sori** in the apices of short segments; involucre bivalvate, cleft nearly to the base, lips round to moderate acute at apex, serrate at margin; receptacles clavate. included. **Fig. 6.26**

Thailand.- NORTHERN: Chiang Mai (Doi Phahom Pok, Doi Sutep, Doi Inthanon, Doi Hua Mot), Phitsanolok (Phu Miaug), Tak (Ban Mosoe); NORTH-EASTERN: Loei (Phu Luang); SOUTH-EASTERN: Prachin Buri (Khao Yai),

Chanthaburi (Khao Soi Dao); SOUTH-WESTERN: Prachuap Khiri Khan (Khao Luang).

Distribution.- N. India to Japan (type south to Taiwan and Vietnam).

Ecology.- On mossy tree trunks in Hill evergreen forest at 1050 m altitudes.

Specimen examined. BCU: Y. Yuyen 198.

2. Hymenophyllum exsertum Wall. ex Hook., Sp. Fil. 1: 109, pl. 38A, 1844.- *Mecodium exsertum* (Wall. ex Hook.) Copel.; Holttum, Rev. Fl. Malaya 2: 86. f. 28. 1955; Bedd., Handb.: 30. f. 16. 1969; Tagawa & K. Iwats., Fl. Thailand 3(1): 73. 1979.

Rhizome wing, sparsely brown hair throughout, laxly branched, about 0.3 mm diam. **Stipes** remote, sparsely brown hair on the abaxial side, about 1-1.5 cm long, winged on the upper part; rachis hairy throughout on the lower surface, winged toward the apex. **Lamina** variable in shape and size, oblong-ovate to oblong-lanceolate, round to acute at apex, bipinnatifid, up to 4-5 by 1.5-2 cm, wings at the upper part broader; pinnae 8-10 pairs, oblong to oblong-lanceolate, slightly falcate, round to moderately acute at apex, 1 cm long, 0.5 cm wide, with a few to several segments; ultimate segment to 1.5 mm long, 1 mm broad, entire and flate; hairs on every axis, brown; texture herbaceous, pale green. **Sori** usually on upper side of pinnae, dispersing from near rachis outward, base constricted; involucre bivalvate, cleft nearly to the base; lips subtriangular, moderately acute, entire and flat, to 2 mm long, 1 mm broad; receptacle clavate. included. **Fig. 6.27**

Thailand.- NORTHERN: Chiang Rai (Doi Tung, Doi Phacho), Mae Hong Son (Doi Khun Huai Pong), Chaing Mai (Doi Phahom Pok, Doi Suthep, Doi Inthanon, Doi Chang), Lamphun (Doi Khun Tan), Phitsanulok (Phu Miang); NORTH-EASTERN: Loei (Phu Luang, Phu Kradueng); CENTRAL: Nakhon Nayok (Khao Yai); SOUTH-EASTERN: Chanthaburi (Khao Soi Dao), Trat (Khao Kuap); SOUTH-WESTERN: Kanchanaburi (Khao Ri Yai); PENINSULAR: Krabi (Phanom Bencha), Ranong (Khao Phota Chongdong), Nakhon Si Thammarat (Khao Luang), Trang (Khao Sung, Khao Chong).

Distribution.- N. India (type from Nepal), S. China, Upper Myanmar, Indochina, south to Malaysia.

Ecology.- On mossy tree trunks in Hill evergreen forest at 1050 m altitudes.

Specimen examined.- BCU: Y. Yuyen 193; T. Boonkerd 93.

ORDER GLEICHENIALES

GLEICHENIACEAE

Holttum, Rev. Fl. Malaya 2: 61. 1955.

Rhizome long-creeping, the apical part covered with stiff hairs or with scales. **Lamina** usually long, scrambling or climbing; main rachis bearing opposite pairs of lateral branches, the apical bud protected by hairs or scales and often also by stipule-like leaflets; leaflets lobed almost to the costa; vein forked, all free. **Sori** on vein, terminal or not or sporangia few, rather large, without indusium.

DICRANOPTERIS

Bernh., Schrad. Neues J. 1(2): 26, 28. 1806.

Rhizome creeping. **Lamina** pinnate or pseudodichotomous; veins forked; hairs on young part of plants multicellular, variously branched, scales wanting. **Sporangia** 8-15 or more in a sorus.

Dicranopteris linearis (Burm. f.) Underw. var. **linearis**, Bull. Tor. Bot, Club 34: 249. 1907; Holttum, in Fl. Mal. II. 1: 33. f. 12, 14 f-i. 1959; Tagawa & K. Iwats., Fl. Thailand 3(1): 55. 1979; Devol, Fl. Taiwan vol. 1. 2 nd ed.: 43. 1980.- *Polypodium linearis* Burm. f., Fl. Ind.: 235. t. 67. f. 2. 1768.- *Gleichenia linearis* (Burm. f.) Clarke, Tr. L. Soc. II. Bot. 1: 428. 1880; Holttum, Rev. Fl. Malaya 2: 68. f. 16. 1955; Bedd., Handb.: 4. f. 1. 1969.

Rhizome widely creeping, slender, hairy, hairs shining brown stiff hairs. **Stipes** erect, about 30-50 cm long, stramineous or brown, glabrescent, apical bud protected by a pair of deeply cordate bluntly. **Pinnae** 2 or 3 time forked, the two branches at each fork nearly equal; ultimate branches about 13-25 cm long, 2.5-6 cm wide; oblong-lanceolate, ultimate segments linear, entire, round at apex, up to 3 cm long, 4 mm broad; texture firm, lower surface slightly glaucous, glabrescent, veins more or less prominent on lower surface and hairy, 1-3 time forked. **Sori** in a single row at each side of costules. each 10-15 sporangia. **Fig. 6.30**

Thailand.- NORTHERN: Chiang Rai (Mae Ton, Doi Chang, Doi Tung, Doi Phacho), Chiang Mai (Doi Chiang Dao, Doi Hua Mot, Doi Suthep), Lampang (Thoen), Lamphun (Doi Khun Tan); NORTH-EASTERN: Loei (Phu Luang, Phu Kradueng);

SOUTH-EASTERN: Prachinburi (Khao Yai), Chanthaburi (Makham, Khao Sabap), Trat (Ko Chang); PENINSULAR: Ranong (Muang Laaen), Chumpon (Ban Thung Maha), Surat Thani (Ban Don), Nakhon Si Thammarat (Khao Luang, Thung Song), Phuket (Ko Mak), Trang (Khao Chong), Yala (Bannang Sata, Padang Besar).

Distribution.- Tropical and subtropical regions in the Old World (type from Ceylon), northwards to Central Japan.

Ecology.- In clearing at edge of Hill evergreen forest at 1050 m altitudes.

Vernacular.- Kiku kachoei (กิ๊กุกะเจ้ย) (Karen/Northern); Kut pit (กูดปิ้ด), Kut muk (กูดหมึก) (Northern); Kut taem (กูดแต้ม), Chon lek (โจ้นเหล็ก), Chon (โชน) (Peninsular); Kue kae (กือแก), Ruesae (เรือแซ) (Malay/Peninsular).

Specimens examined.- BCU: Y. Yuyen 185; P. Rachata 55; T. Boonkerd 1180, 1469.

ORDER SCHIZAEALES

SCHIZAEACEAE

Holttum, Rev. Fl. Malaya 2: 49. 1955.

Rhizome creeping, without scales, densely hairy. **Lamina** simple to bipinnate. **Sporangia** on special lobes, in two distinctly rows, on each lobed covered by indusium.

LYGODIUM

Sw., Schrad. J. Bot. 1800 (2): 106. 1801.

Rhizome creeping, hairy. **Lamina** monostichous, twining, indeterminate growth; primary rachis-branches short, the apex dormant and covered with hairs; secondary rachis-branches bearing leaflets in pinnate arrangement; veins free or reticulate. **Sorophore** on end lobed covered by indusium.

Key to the species

1. Primary rachis-branches distinct; leaflets articulate at base, about 1.4 by 1 cm **1. L. microphyllum**
1. Primary rachis-branches indistinct; leaflet-stalks not thickened at base, ultimate lobes up to 11 by 2 cm **2. L. salicifolium**

1. Lygodium microphyllum (Cav.) R. Br., Prod.: 162. 1810; Holttum in Fl. Mal. II. 1: 47. f. 5 e-f, 6, 7. 1959; Bedd., Handb.: 455. f. 282. 1969; Tagawa & K. Iwats., Fl. Thailand 3(1): 60. 1979; Devol, Fl. Taiwan vol. 1. 2 nd ed.: 84. pl. 26. 1980.- *Ugenia microphylla* Cav., Ic. Descr. Pl. 6: 76. t. 595. 1801.- *Lygodium scandens* Sw., Schrad. J. Bot. 1800(2): 106. 1801; Holttum, Rev. Fl. Malaya 2: 58. f. 12. 1955.

Rhizome widely creeping, irregularly branching, densely covered with blackish brown hairs. **Lamina** climbing, sometime to several metres. **Stipes** about 10 cm long, dark-stramineous, glabrescent, very narrowly winged in the upper part; rachis like the upper part of stipes, stramineous, glabrescent narrowly winged throughout; pinnae numerous, up to 8-9 cm apart; primary rachis- branches, 5 mm. long, the apex densely covered with brown hairs, dormant but occasimally protruding to some extent; secondary rachis-branches 5-7 cm long, glabrescent, narrowly winged; leaflets several in pairs on secondary rachis-branches, with distinct stalk 2-3 mm long, deltoid to bolong-subdeltoid, gradually narrowing towards moderately acute to round at apex, subtruncate on broadly cuneate at more or less auricle base, entire at margin; texture thin, pale green, distinctly jointed to their stalks and regularly falling when old, glabresent, about 1-4 by 1 cm. **Sporangia-bearing** lobes narrow, protruding at margin of segment, 2-7 mm long, about 1mm broad; indusia serrate at margin, glabrous. **Fig. 6.32**

Thailand.- NORTHERN: Chiang Mai (Tat Noi, Doi Suthep), Lampang (Mae Tam, Ban Du); NORTH-EASTERN: Loei (Phu Kradung); CENTRAL: Nakhon Nayok (Khao Yai); SOUTH-EASTERN: Chanthaburi (Makham, Khao Sabap), Trat(Ban Saphan Hin, Ko Chang); PENINSULAR: Surat Thani (Ban Don, Ko Samui, Khun Thale), Song Khla (Hat Yai), Yala(Bannang Sata).

Distribution.- Tropics of the Old World (Type from Luzon), from Africa to Melanesia and Australia, north to the Ryukyus and south to New South Wales.

Ecology.- Climbing on bushes in open area in Mixed deciduous forest at 330 m. altitudes.

Vernacular.- Kachot nu (กะฉอดหนู) (South-eastern); Liphaoyung (ลิเภาฆุ่ง) (Peninsular).

Specimens examined.- BCU: Y. Yuyen 6; T. Boonkerd 681, 735, 1561.

2. Lygodium salicifolium C. Presl, Suppl. Tent. Pterid.: 102. 1845; Holttum In Fl. Mal. II. 1: 51. f. 6. 10, 13 a-b. 1959; Tagawa & K. Iwats., Fl. Thailand 3(1): 64. 1979.- *Lygodium flexuosum* auct. non (L.) Sw.: H. Christ, Bot. Tidsskr. 24: 112. 1901; Holttum, Rev. Fl. Malaya 2: 57. 1955.- *Lygodium circinatum* auct. non (Burm. f.) Sw.: H. Christ, Bot. Tidsskr. 24: 112. 1901.

Rhizome short-creeping, densely covered with dark-brown hairs. **Lamina** climbing, usually several metres long. **Stipes** about 35 cm or more long, stramineous, with dark brown basal portion, minutely hairy at base, glabrescent at upper portion, narrowly winged on the upper part; rachis winged throughout, puberulous on the upper surface between the wings, stramineous, primary rachis-branches very short, up to 1 mm, the apex dormant, covered with downy pale brown hairs; secondary rachis-branches pinnate, 3-4 pairs on each side, and simple or forked terminal leaflet, oblong to subdeltoid in outline, acute at apex, 21 by 18 cm; tertiary leaflets of lower branches palmate, the base distinctly cordate, those of the distal part of plants trilobed, hastate or simple, the base of lobe distinctly cordate, the ultimate lobe up to 11 cm long, 2 cm broad, acute to moderate acute at apex, distinctly serrate at margin, with distinct stalk at base, the stalks up to 1 cm long, winged, sparsely hairy, without articulation; texture subcoriaceous, glabrous above, costules sparsely hairy below; veins 1-3 times forked. **Sporangia-bearing** lobes protruding at margin of tertiary leaflets, up to 1-2 mm long, 1 mm broad; indusia dark-brown, serrate margin, glabrous. **Fig. 31**

Thailand.- NORTHERN: Chiang Rai (Doi Tung, Doi Chang, Nam Mae Kok), Chiang Mai (Doi Chiang Dao, Doi Suthep, Tha Ko), Phrae (Huai Ton Yang, Mae Sai); NORTH-EASTERN: Loei (Phu Luang); EASTERN: Nakhon Ratchasima; CENTRAL: Nakhon Nayok (Khao Yai); SOUTH-EASTERN: Chanthaburi (Makham, Khao Sabap), Chon Buri (Ban Bung), Trat (Laem Ngop, Ko Chang); SOUTH-WESTERN: Kanchanaburi (Kroeng Kawia, Sai Yok), Prachuap Khiri Khan (Bang Saphan); PENINSULAR: Surat Thani (Ban Don, Ko Tao), Phangnga (Khao Nang Hong), Nakhon Si Thammarat (Thung Song, Ronphibun, Khiriwong), Trang (Khao

Chong), Phatthalung, Satun (Tarutao), Narathiwat (Bancho Falls, Sungai Kolok), Yala (Bannang Sta).

Distribution.- Assam to Yunnan, Indochina, Hainan, Taiwan, Throughout Malesia (type from Singapore), southeast to New Guinea and Micronesia.

Ecology.- Climbing on shrubs or on branches of trees in Mixed deciduous forest at 300 m. altitudes.

Vernacular.- Kut khue (กูดคือ), Saiphan phi (สายพานผี), U taphao (อู่ตะเภา) (Northorn); Kachot (กะฉอด), Kachot nu (กะฉอดหนู) (South-Eastern); Yan i-phao (ย่านอิเภา), Yan yai phao (ย่านยายเภา) (Peninsular); Libu (ลิบู) (Malay/ Peninsular).

Uses.- Stems usesd in handicraft.

Specimens examined.- BCU: Y. Yuyen 173; BKF: Bunnak 474; Gen Murata et al. T51292; K. Iwatsuki et al. T10922; K. Larsen et al. 1641.

ORDER DICKSONIALES

DENSTAEDTIACEAE

Holttum, Rev. Fl. Malaya 2: 302. 1955.

Rhizome creeping, covered with hairs. **Lamina** medium to large and much divided; ultimate leaflets more or less unequal at base; veins all free; texture thin or firm, never fleshy or leathery. **Sori** terminal on veins and either (a) marginal and enclosed in a cup, or (b) near the margin and more or less protected by a small reflexed lobe of the margin, or (c) near the margin and protected by pouch-shaped indusium attached below and at the side of the receptacle.

MICROLEPIA

C. Presl, Tent. Pterid.: 124. 1836.

Rhizome creeping, covered with short hairs. **Stipes** rather close, hairy. **Lamina** pinnate to pinnately decompound, ultimate pinnules usually obliquely incised in most cases hairy; veins all free. **Sori** terminal on veins, usually close to margin of lobes; indusia attached by side and base, rather thin, thus half cup-shaped, often hairy.

Key to the species

1. Fronds bipinnate to tripinnatifid
   2. Lamina up to 70 cm long; pinnules to 3 cm long; texture glabrous except on veins **3. M. strigosa**
   2. Lamina up to 100 cm long; pinnules to 8 cm long; texture densely hairy throughout **1. M. puberula**

1. Fronds tripinate; up to 60 by 50 cm; rachis of pinnae pilose with solf spreading hairs; veins not so distinct on lower surface of lobes **2. M. speluncae**

1. Microlepia puberula v. A. v. R., Bull. Jard. Bot. Buit, II. 11: 17. 1913; Holttum, Rev. Fl. Malaya 2: 312. f. 179. 1955; Tagawa & K. Iwats., Fl. Thailand 3(1): 120. f. 8: 3. 1979.

Rhizome creeping, thick, densely hairy at apex, glabrescent in older part. **Stipes** stramineous or brown, up to 60-100 cm long, almost glabrous throughout. **Lamina** bipinnate to tripinnatisect, up to 100 cm long, 60 cm wide; rachis stramineous or brown, grooved on upper surface, rather densely pubescent on upper portion; lateral pinnae more than 10 pairs, upper ones gradually reduced in size, the basal largest ones oblong-subtriangular, gradually narrowing towards caudately acuminate apex, distinctly stalked at base, up to 30 cm long, 15 cm wide; costae like the upper part of rachis; densely hairy throughout; larger pinnules oblong-subtriangular; long cuadate at apex, unequally cuneate at base, basal acroscopic lobes large, basiscopic ones smaller than the next anterior ones, pinnatisect, stalked at base, 8 cm long, 2.5 cm wide; costules densely hairy on both surface; ultimate lobes oblong, oblique, or spathulate in larger ones, entire or obscurely undulate at margin, round at apex; veins more or less covered with hair below, green; texture papyraceous to chartaceous, hairy on the under surface of laminar parts. **Sori** at or a little within the margin of lobes; indusia shallowly cup-shaped, hairy. **Fig. 6.34**

Thailand.- NORTHERN: Chiang Mai (Doi Suthep); SOUTH-WESTERN: Kanchanaburi (Song Tho); PENINSULAR: Yala (Betong).

Distribution.- W. Malesia.

Ecology.- On rather dry slope in Hill evergreen forest at 1050 m altitudes.

Specimens examined.- BCU: Y. Yuyen 154; BKF: J. F. Maxwell 95-939.

2. Microlepia speluncae (L.) T. Moore, Ind. Fil.: 93. 1857; Holttum, Rev. Fl. Malaya 2: 314. 1955; Bedd., Handb.: 67. 1969; Tagawa & K. Iwats., Fl. Thailand 3(1): 118. f.

7: 7, 8. 1979; Shieh, Fl. Taiwan vol. 1. 2 nd ed.: 250. 1980..- *Polypodium speluncae* L., Sp. Pl.: 1093. 1753.- *Microlepia hancei* Prantl, Arb. Bot. Gart. Breslua 1: 35. 1892.- *Microlepia speluncae* var. *hancei* (Prantl) C. Chr. & Tardieu, Not. Syst. 6: 9. 1937; Holttum, Rev. Fl. Malaya 2: 315. f. 182. 1955.- *Microlepia pilosula* C. Presl ex Prantl, Arb. Bot. Gart. Breslau 1: 36. 1892.- *Microlepia speluncae* var. *pubescens* (Hook.) Sledge, Kew Bull. 11: 525. 1956.- *Microlepia speluncae* var. *villosissima* C. Chr., Gard. Bull. S. S. 4: 399. 1929; Holttum, Rev. Fl. Malaya 2: 315. 1955.

Rhizome wide-creeping, almost naked in the older part, deep brown, about 7 mm diam. **Stipes** stramineous or brownish, sparsely hairy throughout, up to 50-60 cm long. **Lamina** tripinnate, up to 60 cm long, 50 cm wide, basal pinnae usually some what reduced; rachis stramineous, grooved on upper side, hairy throughout; larger pinnae oblong-subtriangular broadly cuneate to subtruncate at base, broadest at base, gradually narrowing towards cuadately acuminate apex, about 27 cm long, 7 cm wide; costa grooved on upper surface, hairy; upper pinnae gradually reduced in size; largest pinnules oblong-subtriangular, gradually narrowing towards apex, unequally cuneate at base up to 3.5 cm long, 1.5 cm wide, shortly stalked or subsessile at upper portion; segment lobed, oblong to subquadrangular, round to acute at apex, unequally cuneate at sessile base, 6 by 3mm; ultimate lobes spathulate, round to acute at apex, entire or undulate at margin; veins pinnate, indistinct on both surface, variously hairy; texture softly papyraceous, greenish above, pale below, variously hairy on axes or on lamina surface. **Sori** a little within the margin of lobes, small; indusia cup-shaped, hairy. **Fig. 6.35**

Thailand.- NORTHERN: Chiang Rai (Doi Tung, Mae Nam Kok, Doi Phacho), Chiang Mai (Doi Chiang Dao, Doi Suthep, Mae Suai, Doi Inthanon, Wang Tao), Mae Hong Son (Mae Sariang), Lampang, Tak (Huai Krasa, Ban Musoe, Lan Sang); NORTH-EASTERN: Phetchabun (Phu Miang), Loei (Phu Luang; CENTRAL: Nakhon Nayok (Khao Yai); SOUTH-EASTERN: Chon Buri (Si Racha), Chanthaburi (Khao Soi Dao); PENINSULAR: Chumpon (Lam Lieng, Khao Thalu), Surat Thani (Ko Tao), Phuket (Khao Thong Lang), Nakhon Si Thammarat (Khao Luang), Trang (Khao Chong), Satun, Narathiwat (Waeng, Bacho Falls), Yala (Bannang Sata).

Distribution.- Pantropic.

Ecology.- On mountain slopes in open area or in light shade in Mixed deciduous forest and in Dry evergreen forest at 400 m altitudes.

Specimens examined.- BCU: Y. Yuyen 144; BKF: B. Hansen et al. 12031; Chamlong & Tem 1170; J. F. Maxwell 98-814, 95-998.

3. Microlepia strigosa (Thunb.) C. Presl, Epim.: 95. 1849; Holttum, Rev. Fl. Malaya 2: 310. f. 177. 1955; Bedd., Handb.: 67. 1969; Tagawa & K. Iwats., Fl. Thailand 3(1): 116. f. 8: 2. 1979; Shieh, Fl. Taiwan vol. 1. 2 nd ed.: 251. 1980.- *Trichomanes strigosum* Thunb., Fl. Jap.: 339. 1784.

Rhizome wide-creeping, about 4-5 mm diam, densely covered with yellow brown setose hairs about 2 mm long. **Stipes** stramineous or brownish, densely pubescent especially in the grooves on upper surface or glabrescent in older ones, up to 40 cm long. **Lamina** bipinnate or tripinnatifid in larger fronds, up to 40-70 cm long, 25-35 cm wide; ovate-oblong to oblong-lanceolate, acuminate at apex; rachis like the upper part of stipes, distinctly grooved on upper side, the groove not joined to that of pinna rachis, densely pubescent below; lateral pinnae sometimes more than 20 pairs, a few lower ones slightly reduced or not, the upper gradually reducing in size, the largest one straight, ascending, distinctly stalked, linear-subtriangular, gradually narrowing towards long-caudate acuminate apex, cuneate at base, up to 20 cm long, 4-5 cm wide; the largest pinnules oblong to oblong-subdeltoid; oblique, moderately acute at apex, subtruncate anteriorly and very narrowly cuneate posteriorly at base, deeply lobed to pinnatisect, up to 3 cm long, 1 cm wide, sessile or petiolulate; ultimate lobe round to spatuliform, obcurely undulate at margin; veins pinnate, veinlets forked, distinct on undersurface of lobe, paler, hairy; texture softly chartaceous, deep green above, glabrous except on veins. **Sori** between the crenae of lobes, submarginal; indusia rather broadly cup-shaped, small, less than 1 mm broad, hairy. **Fig. 6.36**

Thailand.- NORTHERN: Chiang Mai (Doi Khun Huai Pong, Doi Suthep, Doi Inthanon, Doi Hua Mot), Lampang; EASTERN: Nakhon Ratchasima (Bu Phram); PENINSULAR: Chumpon (Khao Tong), Yala (Khao Kala Khiri).

Distribution.- Himalayas to Ceylon and Polynesia, northwards to Japan (type).

Ecology.- On mountain slopes usually in Hill evergreen forest at 1050 m altitudes.

Specimens examined.- BCU: Y. Yuyen 40; P. Rachata 150, 168; T. Boonkerd 693, 710; BKF: M. Tagawa et al. T3013; K. Iwatsuki et al 181.

DICKSONIACEAE

Holttum, Rev. Fl. Malaya 2: 112. 1955.

Tree-ferns, with tall or stout trunks or prostrate, hairy. **Lamina** large, pinnately decompound; veins all free. **Sori** terminal on the veins, protected by indusium consisting of two concave flaps, one from the upper side one from the lower.

CIBOTIUM

Kaulf., Enum.: 229. 1824.

Rhizome massive, densely covered with golden yellow long hairs. **Lamina** very large, pinnately decompound; veins forked, all free. **Sori** terminal on veins submarginal, protected by two indusia.

Cibotium barometz J. Sm., Lond. J. Bot. 1: 437. 1842; Holttum, Rev. Fl. Malaya 2: 114. f. 45. 1955; in Fl. Mal. II. 1(2): 165. f. 33. a-c. 1963; Bedd., Handb.: 24. f. 8. 1969; Tagawa & K. Iwats., Fl. Thailand 3(1): 109. f. 6: 8-10. 1979; Devol, Fl. Taiwan vol. 1. 2nd ed: 131. 1980.- *Polypodium barometz* L., Sp. Pl. 2: 1092. 1753.

Rhizome massive, prostrate, very densely covered with golden yellow hairs, bearing a tuft of large fronds. **Stipes** thick, sometimes attaining to 2 mm diam, up to 120 cm long, densely covered with shining, golden yellow, long (more than 4 cm long in some larger ones), slender or warty hairs at base, the hair on upper part not so dense, brown to darker, setose, gradually becoming shorter upwards. **Lamina** bipinnate, large, up to 130 cm long, 150 cm in width; pinnae many, the largest ones up to 75 cm long, 30 cm wide, with numerous pinnules; pinnules deeply pinnatifid throughout, very shortly stalked or subsessile at posterior parts of pinnae, linear-lanceolate, gradually narrowing towards acuminate at apex, broadly cuneate to subtruncate at base, 15 cm long, 2.5 cm wide; ultimate segment oblong, oblique to subfulcate, acute at apex, shallowly but distinctly dentate at margin, glaucous in lower surface, 0.8-1.5 cm long, about 3 mm broad, with intervals of 5 mm between the adjacent costules; costae and costules more or less covered with pale, entangled, flaccid, appress hairs below; veins distinct, once (or twice in larger lobes) forked, sparsely hairy below. **Sori** terminal on usually unbranched lower veins, parallel to edge of lobes, protected by two indusia, outer indusia round, inner ones elongate at maturity, oblong. **Fig. 6.33**

Thailand.- NORTHERN: Chiang Rai (Doi Tung, Mae Nam Kok, Doi Phacho), Chiang Mai (Doi Phahom Pok, Doi Chiang Dao, Doi Hua Mot), Lampang, Phitsanulok (Thung salaeng Luang); NORTH-EASTERN: Phetchabun (Phu Miang), Loei (Phu Luang, Phu Kradueng); EASTERN: Nakhon Ratchasima (Khao Laem); CENTRAL: Nakhon Nayok (Khao Yai); SOUTH-EASTERN: Chanthaburi (Khao Soi Dao), Trat (Ko Chang); PENINSULAR: Yala (Gunong Ina).

Distribution.- Himalayas to S. China and Taiwan, South to. W Malesia, north to the Ryukyus.

Ecology.- In Tropical evergreen forest at 880 m altitudes.

Vernacular.- Kut phipa (กูดผีป่า), Kut phan (กูดพาน) (Northern); Khon kai noi (ขนไก่น้อย) (North-eastern); Hatsadaeng (หัสแดง) (Eastern); La-ong fai fa (ละอองไฟฟ้า), Wan kai noi (ว่านไก่น้อย) (Central); Kut sua (กู คเสือ), Pho si (โพสี), Ninla phosi (นิลโพสี) (Peninsular).

Uses.- Locally used for local medicine, especially silky hairs on bud used for fresh wound.

Specimens examined.- BCU: Y. Yuyen 75; P. Rachata 69; T. Boonkerd 53, 67, 1300.

LINDSAEACEAE

Shieh, Fl. Taiwan vol. 1. 2 nd ed.: 259. 1980.

Rhizome creeping, terrestrial or climbing, covered with shining scales or with hairs. **Lamina** pinnately divided; veins free or anastomosing. **Sori** marginal, terminal on veins, simple or joined to form fusion-sori of varying length; indusium opening towards the margin.

Key to the genera

1. Frond pinnate to bipinnate; pinnae of pinnate frond or pinnules of bipinnate frond dimidiate or not dimidiate; sori uniting apices of many veins, or on fewer vein-ends with the side of the indusium free **1. Lindsaea**
1. Frond tripinnate to quadripinnate; pinnules usually short, or if long the sori uniting at the ends of few veins **2. Sphenomeris**

1. LINDSAEA

Dryand., Trans. L. Soc. 3: 39. 1797.- *Isoloma* J. Smith, J. Bot. 3: 414. 1841.

Rhizome *creeping, terrestrial or climbing covered with hairs or scales.* ***Lamina*** *simply pinnate to bipinnate; veins free or anastomosing.* ***Sori*** *marginal, terminal on* veinlets, joining the apex of veins to form fusion-sori along the margin of lobes; indusia opening outwardly.

Key to the species

1. Pinnae shortly stalked, not articulate to rachis, 3-7 pairs; veins anastomosing **2. L. ensifolia**
1. Pinnae sessile, articulate to rachis, about 50 pairs; veins pinnate, forked, all free **1. L. divergens**

1. Lindsaea divergens Hook. & Grev., Ic. Fil.: t. 226. 1831; Bedd., Handb.: 76. f. 38. 1969; Kramer in Fl. Mal. II. 1: 233. 1971; Tagawa & K. Iwats., Fl. Thailand 3(2): 142. 1985.- *Isoloma divergens* (Hook & Grev.) J. Smith, Hook. J. Bot. 3: 414. 1841; Holttum, Rev. Fl. Malaya 2: 337. f. 195. 1955.

Rhizome short-creeping, nearly black, bearing close fronds, densely scales; scales linear-lanceolate, up to 2 mm long, 0.5 mm broad at base, dark brown to nearly black, shining, stiff, distal part hair-like. **Stipes** brown to darker, polish, grooved on upper surface, scaly at base and sparsely on upper portion, about 35 cm long; rachis like the upper part of stipe, rounded beneath. **Lamina** 1-pinnate, about 80 cm long and 12 cm wide; pinnae close, about 50 pairs, sessile, jointed to rachis, patent or overlapping at their bases linear, round, acute to acuminate at apex, broadly cuneate at basiscopic, truncate at acroscopic bases, pinnae 6-8 cm long and 1-1.5 cm wide, entire; the lower ones gradually reduced to auricles; terminal pinnae large, irregularly lobed at basal part; texture subcoriaceous; veins pinnate, veinlets forked, free, except as joined by sori, hardly visible on lower surface.**Sori** marginal, continuous along whole length; indusia firm, pale, entire, hardly reaching the margin of pinnae. **Fig. 6.37**

Thailand.- PENINSULAR: Songkhla (Khao kaeo).

Distribution.- Malaysia (type), Sumatra, Borneo and Palawan.

Ecology.- In rocks crevice in Mixed deciduous forest at 500 m altitudes.

Specimens examined.- BCU: Y. Yuyen 125.

2. Lindsaea ensifolia Sw., Schrad. J. Bot. 1800(2): 77. 1801; Holttum, Kramer in Fl. Mal. II. 3: 211. 1971; Shieh, Fl. Taiwan vol. 1. 2 nd ed.: 260. 1980; Tagawa & K. Iwats., Fl. Thailand 3(2): 131. 1985.- *Schizoloma ensifolium* (SW.) J. Smith., J. Bot. 3:414. 1841; Holttum, Rev. Fl. Malaya 2: 346. f. 200. 1955; Bedd., Handb.: 80. f. 41. 1969.- *Linsaea griffitthianum* Hook., Sp. Fil. 1: 219. t. 68B. 1846.- *Schizoloma griffithianum* (Hook.) Fée, Gen. Fil.: 108. 1852.- *Diplazium bantamense* auct. non Bl.: H. Christ, Bot. Tidsskr. 24. 108. 1901.

Rhizome short-creeping, 3-5 mm diam, bearing fronds close together, brown, scaly at least apically; scales linear-subtriangular, up to 1.5 mm long, 0.3 mm broad, brown, light reddish brown. **Stipes** stramineous to castaneous at leats at base, about 15-45 cm long, grooved. **Lamina** simply pinnate, ovate to oblong-lanceolate in outline, lateral pinnae 3-7 pairs, linear-lanceolate, caudately acuminate at apex, sometime forked at apex, cuneate, rounded or subtruncate at base, very shortly stalked, entire at margin, up to 5-20 cm broad, rather variable, small one about 0.5 cm broad; terminal pinnae like lateral ones, texture subcoriaceous; veins anastomosing forming 2-4 rows of areoles at each side of costa, distinct beneath; costa raised on lower surface. **Sori** continuous along margin; indusia firm, nearly reaching the adges. **Fig. 6.38**

Thailand.- NORTHERN: Chiang Mai (Doi Chiang Dao, Doi Suthep, Buak Ha), Phitsanulok (Thung Salaeng Luang); NORTH-EASTERN: Loei (Phu Luang, Phu Kradueng), Nong Khai (Phon Phisi); EASTERN: Ubon Ratchatthani; CENTRAL: Nakhon Nayok (Khao Yai); SOUTH-EASTERN: Rayong (Khao Chamao), Chanthaburi (Khao Sabap, Makham, Phriu), Trat (Ko Chang, Ko Kut, Tha San Fall, Ban Sapan Hin); SOUTH-WESTERN: Kanchanaburi (Khao Ngi Yai); PENINSULAR: Krabi, Ranong (Ko Chang Lat), Surat Thani (Ko Tao, Ban Don), Phu Ket (Ko Boi Noi), Nakhon Si Thammarat (Tha Samet), Trang (Tahbum), Satun, Yala (Ban Malao, Ban Chana).

Distribution.- Old world Tropics from W. Africa (type from Mauritus) to Australia and Polynesia, north to Ryukyus.

Ecology.- Terrestrial on rather dry slopes in open areas in Hill evergreen forest at 1050 m altitudes.

Vernacular.- Hang nok kaling (หางนกกะลิง) (Central).

Specimens examined.- BCU: Y. Yuyen 186; P. Rachata 60, 128; T. Boonkerd 40, 1389.

2. SPHENOMERIS

Maxon, J. Wash. Acad. Sci. 3: 144. 1913.

Rhizome creeping, scaly with narrow shining dark brown scales. **Lamina** bipinnate to quadripinnate. **Sori** terminal on veinlets, close to margin; indusia attached by base, opening outwardly.

Sphenomeris chinensis (L.) Maxon var. **divaricata** (H. Christ) K. U. Kramer, Blumea 15: 572. 1968; in Fl. Mal. II. 1: 183. f. 1. 1971; Tagawa & K. Iwats., Fl. Thailand 3(2): 148. 1985.- *Odontosoria chinensis* var. *divaricata* H. Christ, J. Bot. II. 2: 23. 1909.- *Stenoloma chusana* var. *tenuifolia* auct. non (Sw.) C. Chr.: Holttum, Rev. Fl. Malaya 2: 341. f. 198. 1955.

Rhizome short-creeping, bearing fronds close together, densely scaly; scales red-brown, shining, up to 2.5 mm long, narrow, stiff. **Stipes** up to 35 cm long, stramineous, brownish in lower part, scaly at base; rachis grooved on upper surface of upper part. **Lamina** finely divided to quadripinnate, oblong to narrower, acuminate apex, up to 50 by 8 cm; pinnae alternate, subtriangular, attenuate acuminate at apex, cuneate and shortly stalked at base, tertiary segment dilate; texture papyraceous; veins usually one or two in each ultimate lobes, hardly visible. **Sori** terminal on veinlets or uniting the apices of 2-3 veinlets, close to apex of lobes; indusia attached at base and basal part of both sides, toothed. **Fig. 6.39**

Thailand.- NORTH-EASTERN: Loei (Phu Kradueng); SOUTH-EASTERN: Chanthaburi (Khao Soi Dao).

Distribution.- E. Himalayas, SW. China, Myanmar, Indochina (type) and Malesia.

Ecology.- Terrestrial in light shade slope in Hill evergreen forest at 1050 m altitudes.

Specimens examined.- BCU: Y. Yuyen 188; BKF: M. Tagawa et al. T588.

ORDER CYATHEALES

CYATHEACEAE

Holttum, Rev. Fl. Malaya 2: 115. 1955.

Stock erect, forming a massive trunk in most species, when old covered with a mat of black interlacing roots; apex of trunk and base of stipes covered more or less densely with scales. **Stipes** scaly at least near the base. **Lamina** large, usually bipinnate and more or less deeply bipinnatifid; costules of pinnules-lobes nearly at right angles to the costae; veins strictly pinnate, simple or forked. **Sori** one on the veins, the sporangia attached to a small raised receptacle, often mixed with hairs, whitout indusium or with a thin cup-shaped indusium which completely enclosed the sorus when young.

CYATHEA

J. E. Smith, Mém. Acad. Turin. 5: 416. 1793. *Gymnobhaera* Bl., En. Pl. Jav.: 242. 1828.- *Sphaeropteris* Pernh., Schrad. J. Bot. 1800(2): 122. 1801.- *Alsophila* R. Br., Prod.: 158. 1801.

Stock erect, tall, to 10 m or more height, bearing rosette of fronds at apex. **Stipes** scaly at least near the base. **Lamina** large, usually bipinnate and more or less deeply bipinnatifid; veins usually free, simple or forked. **Sori** round dorsal on veinlets, on distinct receptacle; indusia distinct or wanting.

Key to the species

1. Stipes pneumathodes present, in a single row with short distance between each other, about 1 cm in length, warty; pinnae 50 by 20 cm; costule and costules sparesly hairy **1. C. borneensis**
1. Stipes pneumathodes absent, with spines; pinnae 40 by 13 cm; costule and costules scaly beneath **2. C. latebrosa**

1. Cyathea borneensis Copel., Phil. J. Sci. 6: 135. 1911; Holttum, Fl. Mal. II. 1: 110. 1963; Tagawa & K. Iwats., Fl. Thailand 3(1): 103. 1979.- *Cyathea obtusata* Rosentst., Med. Rijksherb. 31: 1. 1917; Holttum, Rev. Fl. Malaya 2: 121. 1955.

Trunk 5 m or more tall. **Stipes** about 20 cm long, warty, brownish, naked, pneumathodes 1 cm in length, in a single row with short distance between each other, main rachis smooth or warty in lower portion, pale brown. **Lamina** bipinnatifid, lower pinnae distant, about 17 cm a part, reduced to 8 cm long, longest about 50 by 20 cm, cuadately acuminate at apex, pinna rachis brown, purplish at base portion, sparsely hairy with pale crispes hairs in grooved; pinnules about 25 pairs, larger ones 2 cm apart, very shortly, patent, oblong-lanceolate, gradually narrowing toward long acuminate apex, truncate at base, about 10 cm long, 2 cm wide, lobed almost to costae, remaining decurrent lamina; lobed oblique, falcate, round to acute at apex, serrate at margin, about 1 cm long, 3 mm broad; texture papyraceous, greenish to yellowish; vein forked, distinct on both surfaces. **Sori** close to costules; receptacle swollen; indusia thin flat, on costular side of receptacles, under matured sori, paraphyses present. **Fig. 6.40**

Thailand.- EASTERN: Buri Ram (Bo Rai); CENTRAL; Nakhon Nayok (Khao Yai); PENINSULAR: Chumpon (Khao Tong, Thasan), Surat Thani (Khao Nong), Nakon Si Thammarat (Khao Luang, Ronphibun), Satun (Klong Thom, Khao Khieo).

Distribution.- Cambodia, Myanmar, Malaysia and Borneo (type).

Ecology.- On rather dry ground near rivers in Dry evergreen forest at 400 m altitudes.

Specimens examined.- BCU: Y. Yuyen 181; BKF: C. F. Van Beusekom & C. Phengkhlai 401; R. Geesink et al. 7436.

2. Cyathea latebrosa (C. Presl) Copel., Phil. J. Sci. 4: 52. 1909; Holttum, Rev. Fl. Malaya 2: 120. f. 48. 1955; Dansk., Fl. Mal. II. 1: 115. 1963; Tagawa & K. Iwats., Fl. Thailand 3(1): 104. 1979.- *Alsophila latebrosa* Wall. ex Hook., Sp. Fil. 1: 37. 1844; Bedd., Handb.: 11. 1969.

Trunk 3-5 m or more tall. **Stipes** 30 cm long, with spines, yellowish brown to darker, scaly at base; scales linear, to 15 by 1 mm, dark brown, shining, stiff, edges paler, ferrugineous, soon abraded. **Lamina** bipinnate-bipinnatifid, about 95 by 80 cm, oblong, acuminate at apex, lower pinnae reduced to 10 cm long, irregular in form, rather distant, larger pinnae about 40 cm long, 13 cm wide, narrowly oblong caudately acuminate at apex, pinna–rachis warty beneath, hairy and sparsely scales on upper surface; pinnules more than 25 pairs, larger ones about 1.6 cm apart, oblong-

lanceolate, gradually narrowing toward acuminate apex, subtruncate at base, sessile, to 6 cm long, 1.5 cm wide, lobed nearly to costa; lobed oblique, falcate, round at apex, entire or slightly serrate at margin, to 7 mm long, 2 mm broad; costae hairy on upper surface, costae and costules scaly beneath with elongate, flat, brown scales in basal part, with pale bullete scales in distal part; texture papyraceous, deep green, paler beneath; vein forked or distal ones simple. **Sori** close to costules; indusia small; scales at costular side of receptacles, hidden by mature sori. **Fig. 6.41**

Thailand.- NORTHERN: Chiang Mai (Doi Suthep); CENTRAL; Nakhon Nayok (Khao Yai); SOUTH-EASTERN; Chanthaburi (Khao Soi Dao), Trat (Ko Chang); PENINSULAR: Chumpon (Thasan), Nakhon Si Thammarat (Khao Luang), Trang (Khao Chang, Khao Sung), Narathiwat (Sungai Padi), Yala (Muang Wieng, Khao Kalakhiri).

Distribution.- Cambodia, Hainan, Malaysia (type), Sumatra and Borneo.

Ecology.- On mountain slopes usually in Tropical evergreen forest or in Hill evergreen forest at 800-1050 m altitudes.

Vernacular.- Kut ton (กูดต้น), Kut phrao (กูดพร้าว) (Northern); Maha sadam (มหาสดำ) (South-eastern).

Uses.- Fibrous trunk used for orchid media.

Specimens examined.- BCU: Y. Yuyen 71, 136; BKF: E. Hennipman 3818; K. Iwats & N. Fukuoka T7393; M. Tagawa et al. T4629; Winit 176.

ORDER PTERIDALES

ADIANTACEAE

Shieh, Fl. Taiwan vol. 1. 2 nd ed.: 302. 1980.

Terrestrial ferns. **Lamina** simple to pinnately compound, monomorphic or dimorphic; veins free. **Sori** oblong on distal ends or on the apical parts of veins, protected by reflexed leaf-margin and opening introsely; sporangia developing in mix sequence.

Key to the genera

1. Fronds simple, entire or palmately lobed
   2. Sori superficial extending along veins; lamina simple, cordate or subhastate at base **3. Hemionitis**
   2. Sori submarginal, protected by reflexed margin flaps; lamina pinnatifid; cordate at base **2. Doryopteris**
1. Fronds pinnate or more amply devided
   3. Sori superficial or submarginal
      4. Sori superficial, without indusia; lower surface of fronds bearing waxy powder **5. Pityrogramma**
      4. Sori at end of veins; margin of fronds flat or more or less revolute **4. Notholaena**
   3. Sori protected by and borne on reflexed margin of leaflets **1. Adiantum**

1. ADIANTUM

L., Sp. Pl.: 1094. 1753.

Rhizome creeping to erect. **Lamina** simple to pinnately decompound or pedate; veins free or rarely anastomosing. **Sori** along veins on inner face of reflexed margin flabs (false-indusia), thus protected between this flap and laminae surface.

Key to the species

1. Pinnae parallelogram, almost sessile
   2. Pinnae lobed more than halfway towards costa, each with a few veinlets; hairy on both surface **1. A. caudatum**
   2. Pinnae lobed less than halfway towards costa, each with several veinlets; usually glabrous on both surface **3. A. zollingeri**
1. Pinnae cresent, with distinct stalk **2. A. phillippense**

1. Adiantum caudatum L., Mant. Alt.: 308. 1771; Holttum, Rev. Fl. Malaya 2: 599. f. 351. 1955; Bedd., Handb.: 83. f. 44. 1969; Shieh, Fl. Taiwan vol. 1. 2 nd ed.: 303. pl. 105. 1980; Tagawa & K. Iwats., Fl. Thailand 3(2): 207. 1985.- *Adiantum malesianum* Ghatak, Bull. Bot. Surv. Ind. 5: 73. f. 1. 1, 4. 6-7. 1963.

Rhizome short, erect, bearing a dense tuft of fronds, covered with scales; scales copious, linear, up to 5 by 0.5 mm, dark brown with pale edges. **Stipes** up to 3-12 cm long, castaneous to black purple, polished, densely hairy with long multicellular brown hairs, scaly at base. **Lamina** 1-pinnate, linear-lanceolate, long tailed at apex, up to 32 by 2.5-3 cm, rachis as stipe, but with shorter denser hair on the upper surface, longer spreading hairs less densely arranged on the shining lower surface, with paler

stiff hairs, prolonged, leafless on apical part, rooting at tip; lateral pinnae gradually becoming smaller upwards, the lower one smaller and reflexed; largest pinnae sessile, almost parallelogram-shaped, round at apex, lower margin almost straight, to form narrowly cuneate base with lower margin, up to 15 by 5 mm, upper and outer margin deeply lobed to more than half the width of pinna, forming narrowing lobed and narrow sinus, lobes 4 or 5, subtruncate and slightly toothed at apex, entire at margin; texture papyraceous, hairy on both surfaces, lower surface with short and long hairs, upper surface with stiff hairs; veins prominent on upper surface but not below. **Sori** on apices of lobes, the reflexed flaps narrow, hairy. **Fig. 6.42**

Thailand.- NORTHERN: Chiang Rai (Doi Tung), Chiang Mai (Doi Chaing Dao, Doi Suthep, Mae Klang), Lampang (Khao Tham Pha Thai), Phrae (Mae Ban), Phitsanulok (Thung Salaeng Luang), Tak (Lan Sang, Ban Na); NORTH-EASTERN: Loei (Phu Luang, Pha Nok Khao), Nong Khai; EASTERN: Nakhon Ratchasima (Pak Thong Chai); CENTRAL: Saraburi (Muaklek), Phra Nakhon Si Ayutthaya; SOUTH-EASTERN: Ban Beung Hills, Chon Buri (Si Racha); Chanthaburi (Pong Nam Ron); SOUTH-WESTERN: Kanchanaburi (Erawan Falls, Wangka, Khao Thalu, Ban Kao), Prachuap Khiri Khan (Bang Saphan); PENINSULAR: Surat Thani (Khao Hua Khwai, Ko Tao, Samui, Ko Paloei), Nakhon Si Thammarat (Thung Song), Phattalong, Phangnga (Kasum), Satun, Pattani, Yala (Bannang Sata, Ban Sai Khao).

Distribution.- Tropics of the Old World in general, from Africa to Polynesia (type from India).

Ecology.- On rather dry slopes in Mixed deciduous forest at 130 m altitudes.

Vernacular.- Kut namkhao (กูดน้ำข้าว) (Northern); Tin tukkae (ตีนตุ๊กแก), Hang nak bok (หางนาคบก) (Central).

Specimens examined.- BCU: Y. Yuyen 159; P. Rachata 241; T. Boonkerd 27, 322, 1378.

2. <u>Adiantum philippinse</u> L., Sp. Pl. 2: 1094. 1753; Holttum, Rev. Fl. Malaya 2: 598. f. 350. 1955; Shieh, Fl. Taiwan vol. 1. 2 nd ed.: 306. pl. 106. 1980; Tagawa & K. Iwats., Fl. Thailand 3(2): 211. 1985.- *Adiantum Lunulatum* Burm. f., Fl. Ind.: 235. 1768; Bedd., Handb.: 82. f. 43. 1969.

Rhizome short, erect or suberect, bearing a tuft of fronds; the apex covered with scales; scales linear, a little broader at base, narrowing to apex, dark, entire, pale at margin, 3 mm long. **Stipes** bright castaneous to black, sparsely scaly at basal portion, glabrous at upper portion, about 4-10 cm long, scales on stipe like those on rhizome exept in being concolorous brown. **Lamina** 1-pinnate, linear-lanceolate to oblong, up to 6-15 cm long, 2-3 cm wide, rachis perfectly glabrous, occasionally prolonged, leafless on upper part, and rooting at tip, more commonly bearing an apical pinna like lateral ones, usually bearing about 6-8 alternate pinnae on each side of rachis; lateral pinnae slightly reduced in size upwards, distinctly slender black stalked; stalked usually 2-3 mm long, with and angle of about 60° to rachis; leaflets crescent-shape, about 1-1.5 by 0.5 cm, in upper leaflets the lower two edges meeting at stalks to form cuneate base, in lower leaflets subtruncate; texture thin, softly herbaceous, glabrous on both surfaces; veins slightly raised, outer edge of leaflets subentire, crisped or lobed to about 1/4 of breadth of leaflets, sinus narrow, lobes round to subquadrangular. **Sori** at margin of leaflets, reflexed soral flaps elongate usually 1-5 mm long. **Fig. 6.43**

Thailand.- NORTHERN: Chiang Rai (Doi Tung), Chiang Mai (Fang, Doi Chaing Dao, Mae Klang, Doi Inthanon, Wang Tao, Doi Saket), Mae Hong Son (Mae La Noi, Bo Luang), Lampang (Haui Thak), Lamphun (Doi Khun Tan), Phitsanulok (Thung Salaeng Luang, Kaeng Sopha), Tak (Lan Sang, Ban Musoe, Wang Chao); NORTH-EASTERN: Phetchabun (Phu Miang), Loei (Phu Luang, Phu Kradueng); CENTRAL: Nakhon Nayok, Bangkok; SOUTH-EASTERN: Prachin Buri, Chon Buri (Si Racha); Chanthaburi (Khao Sabap); SOUTH-WESTERN: Kanchanaburi (Sai Yok, Wangka, Ban Kasi, Thung Kang Yang Hills, Tha Pu); PENINSULAR: Nakhon Si Thammarat (Thung Song).

Distribution.- Throughout the tropics of the Old World (type from Philippines).

Ecology.- On muddy crevices of rocks in Dry evergreen forest at 240 m altitudes.

Vernacular.- Kut hu khwak (กูดหูกวาก), Hua khwak (หัวขวาก), Ya khwak (หญ้าขวาก), Pkak kachot nu (ผักกระฉอกหนู) (South-eastern); Hang ching cha (หางชิงช้า) (Penninsular).

Specimens examined.- BCU: Y. Yuyen 171; P. Rachata 33, 233; T. Boonkerd 441, 1020.

3. Adiantum zollingeri Mett. ex Kuhn, Ann. Lugd. Bat. 4: 280. 1869; Tagawa & K. Iwats., Fl. Thailand 3(2): 208. f. 16. 3. 1985.- *Adiantum caudatum* var. *subgrabrum* Holttum, Rev. Fl. Malaya 2: 600. 1955.

Rhizome short, erect, densely scaly at apex; scales up to 5 mm long, narrow entire, black, polished. **Stipes** up to 12 cm long, castaneous to nearly black, densely hairy with long multicellular on upper surface, brown hairs, scaly at base. **Lamina** 1-pinnate, linear, gradually narrowing upwards, up to 24 by 4 cm; rachis hairy on upper surface, perfectly glabrous on lower surface, prolonged, sometime leafless on upper part, often rooting at tip; upper lateral pinnae becoming smaller and more spaced; lower pinnae smaller and reflexed; larger pinnae sessile, nearly paraellogram-shaped, round at apex, lower margin almost striaght, to form narrowly cuneate base with lower margin, up to 2 by 1 cm, upper and outer margins lobed at most to less than 1/3 of width of pinnae, forming distinct sinus; lobes round or spathulate, round to subtruncate and slightly toothed at apex, each including 8-12 veinlets; texture papyraceous, almost glabrous; vein distinct on both surface. **Sori** on apices of lobes, reflexed flaps circular or elongate, glabrous. **Fig. 6.44**

Thailand.- NORTHERN: Chiang Mai (Doi Chiang Dao, Doi Suthep, Ping Khong, Sop Aep, Mae Klang), Mae Hong Son (Mae La Noi), Lampang (Doi Phalat, Huai Thak), Lamphun (Doi Khun Tan), Phare (Mae Ban), Phetchabun (Nam Nao), Tak (Lan Sang); NORT-EASTERN: Loei (Phu Kradueng, Pha Nok Khao); CENTRAL: Nakhon Nayok (Khao Yai); SOUTH-WESTERN: Uthai Thani (Huai Laeng), Kanchanaburi (Sai Yok, Kaeng Lawa, Khao Nam Tok, Thung Kang Yang Hills), Rachaburi, Prachuap Khiri Khan (Sam Roi Yot, Thap Sakae, Khao Khlongwan); PENINSULAR: Surat Thani (Khao Phra Rahu, Khaolak), Nakhon Si Thammarat (Khiriwong), Phangnga (Thap Put)

Distribution.- Himalayas to W. Malesia (type from Java).

Ecology.- On dry ground in Mixed deciduous forest or Dry evergreen forest at 300 m altitudes.

Vernacular.- Kut bai lex (กูดใบเล็ก) (Northern).

Specimens examined.- BCU: Y. Yuyen 26, 106, 170; T. Boonkerd 62.

2. DORYOPTERIS

J. Smith. J. Bot. 3: 404. 1841.

Rhizome creeping. **Lamina** simple to pinnatifid, basiscopically produced; veins free except in sori, or copiously anastomosing. **Sori** marginal or nearly so, protected by narrow reflexed margin of lobes; paraphyses filamentous.

Doryopteris ludens (Wall. ex Hook.) J. Sm., Hist. Fil. 289. 1875; Holttum, Rev. Fl. Malaya 2: 594. f. 349. 1955; Bedd., Handb.: 120. f. 61. 1969; Tagawa & K. Iwats., Fl. Thailand 3(2): 197. 1985.- *Pteris ludens* Wall. ex Hook., Sp. Fil. 2: 210. 1858.

Rhizome long-creeping, about 3-4 mm diam, bearing distant stipes, about 1.5 cm apart, densely scaly towards the apex; scale linear-subulate, up to 1-2 mm long, dark, with narrow pale edges, entire, glabrous. **Stipes** nearly black, polished, scaly at base, sparsely, hairy throughout, in fertile fronds about 35-45 cm long, in sterile fronds about 25 cm long. **Lamina** dimorphic; the **Sterile fronds:** smaller and less lobed than the fertile, up to 14 by 12 cm, pinnatifid, subdeltiod to triangular, acuminate at apex, cordately at base, usually 5 lobes, the basal lobes the largest, with a few secondary lobes; lobes oblong-subdeltoid to triangular, acuminate at apex, slightly waved, main veins of raised and black below, narrowly grooved aboved, other veins not clearly visible, texture coriaceous, glabrous. **Fertile fronds:** up to 20 cm long and wide, subdeltoid in outline, deeply pinnatisect, usually with three pairs of lobes, the lowest pairs the largest, usually with one or two secondary lobes; lobes linear or linear-subtriangular, caudately acuminate at apex, entire, 1-2 cm broad, up to 13 cm long; main veins distinct on lower surface, black, grooved above. **Sori** continuous along the margin of fronds, a very short interruption at apices of lobes, covered by thin reflexed margin. **Fig. 6.47**

Thailand.- NORTHERN: Chiang Rai (Doi Tham Tu Pu), Chiang Mai (Phong Nam Khao), Mae Hong Son (Doi Tan Ma Keng), Lampang (Mae Somai); NORTH-EASTERN: Loei (Phu Luang); EASTERN: Nakhon Ratchasima (Pak Thong Chai); CENTRAL: Nakhon Nayok (Khao Yai); SOUTH-EASTERN: Chon Buri (Si Racha); Chanthaburi (Khao Soi Dao, Pong Nam Ron); SOUTH-WESTERN: Kanchanaburi

(Sai Yok, Kaeng Lawa, Khao Nam Tok, Thung Kang Yang Hills, Koeng Chada), Rachaburi, Prachuap Khiri Khan (Sam Roi Yot, Thap Sakae, Bang Saphan); PENINSULAR: Chumphon (Ko Wiang, Thap Li Tha Ko), Nakhon Si Thammarat (Thung Song), Phangnga (Khao Suang, Thap Put, Takua Thung), Satun, Yala (Bannang Sata), Trang (Nam Thai).

Distribution.- N. India (type), S. China, Indochina and throughout Malesia.

Ecology.- Terrestrial in Mixed deciduous forest or in Dry evergreen forest at 100-400 m altitudes.

Vernacular.- Kaprok wao (กระปรอกว่าว) (South-eastern); Kut hu kwao (กูดฮู้กวาว) (Northern); Paentako (แพนตาโก) (Penninsular); Foen rachini (เฟินราชินี) (Central).

Specimens examined.- BCU: Y. Yuyen 12; T. Boonkerd 22, 23, 1122.

3. HEMIONITIS

L., Sp. Pl.: 1077. 1753.

Rhizome short. **Lamina** simple or palmately lobed, dimorphic; veins reticulate. **Sori** spreading along veins, naked, without paraphyses but with hair-like scales.

Hemionitis arifolia (Burm. f.) T. Moore, Ind. Fil.: 114. 1859; Holttum, Rev. Fl. Malaya 2: 596. 1955; Bedd., Handb.: 413. f. 245. 1969; Shieh, Fl. Taiwan vol. 1. 2 nd ed.: 314. pl. 110. 1980; Tagawa & K. Iwats., Fl. Thailand 3(2): 191. 1985.- *Asplenium arifolium* Burm. f., Fl. Ind.: 231. 1768.

Rhizome shorts, suberect, scaly; scale narrow brown, pale edge, 2 mm long, entire. **Stipes** deep castaneous to neary black, grooved on adaxial surface, scaly, throughout, about 35 cm long in fertile and about 13 cm in sterile fronds, concolorous. **Lamina** simple, distinct dimorphic; the **Sterile fronds:** narrowly ovate, acute at apex, deeply cordate at base, entire, up to 8 by 5 cm; texture papyraceous bearing scales and hairs on lower surface, green, densely hairy at margin with short multicellular hairs; costa raised on lower surface, the veins reticulate without free veinlet, obscure; **Fertile fronds:** oblong-subdeltoid, up to 10 cm long and 3 cm wide, long acute at apex, sagitate at base, the two basal lobes triangular, moderately acute, entire; texture thiner than the sterile. **Sporangia** along veins, forming a network all over the lower surface, without any protection but scales mixed with sporangia. **Fig. 6.45, 6.46**

Thailand.- NORTHERN: Chiang Mai (Doi Chiang Dao, Doi Suthep), Phitsanulok (Thung Salaeng Luang); NORTH-EASTERN: Khon Khaen (Phu Wiang); SOUTH-EASTERN: Chon Buri (Si Racha); PENINSULAR: Surat Thani (Ban Don), Nakhon Si Thammarat (Chawang).

Distribution.- Ceylon, S. & NE. India (type), S. China, Indochina, W. Malesia to the Philippines.

Ecology.- Terrestrial in open places in Mixed deciduous forest at 500 m altitudes.

Specimens examined.- BCU: Y. Yuyen 92; C. Apasutaya 112.

4. NOTHOLAENA

R. Br., Prod.: 145. 1810.- *Cheilanthes* Sw., Syn. Fil.: 5, 126. 1806.

Rhizome short, erect. **Lamina** pinnately divided; veins all free. **Sori** at end of veinlets, along the margin of lobes.

Notholaena velutina Tardieu & C. Chr., Not. Syst. 6: 167. f. 5-7. 1938; Tagawa & K. Iwats., Fl. Thailand 3(2): 198. f. 15. 2. 1985.

Rhizome short, erect, bearing a tuft of living and older stipes, scaly at apex; scales not very dense, very narrow, consisting of a few row of cell, dark brown, with narrow pale slightly toothed edges, up to 3 mm long. **Stipes** sparsely scaly in lower portion, densely hairy throughout; hairs coarse, light brown, gradually becoming shorter upwards, up to 7-11 cm long, dark purplish to nearly black, polished. **Lamina** oblong-lanceolate, the apex gradually narrowing, often ending in gemmae, up to 15-25 by 4 cm, tripinnatifid; rachis grooved on upper surface, dark brown throughout, hairy, gemmiferous; pinnae 1-1.6 cm remote, oblong-subtriangular, acute at apex, truncate to broadly cuneate at base, distinct stalked; larger ones 2.5 by 2 cm; costa narrowly winged, densely hairy on both surfaces; pinnules about 5 pairs, narrowly oblong, slightly falcate in larger ones, basal one usually the largest; lobe up to 5 pairs, oblong to round, entire, strongly revolute, veins hardly visible; lamina densely hairy, hairs downy, striaght, pale and translucent. **Sori** confined to the margin but appearing to be more or less continuous along margin of fronds. **Fig. 6.48, 6.49**

Thailand.- SOUTH-WESTERN: Prachuap Khiri Khan (Hua Hin, Huai Yang).

Distribution.- S. Indochina (type).

Ecology.- Terrestrial or on dry rocks in open places in Mixed deciuous forest at 120 m altitudes.

Specimens examined.- BCU: Y. Yuyen 23; T. Boonkerd 1433.

5. PITYROGRAMMA

Link, Handb. Gew. 3: 19. 1833.

Rhizome short, ascending. **Lamina** simple to pinnately compound, the lower surface usually cover with waxy powder; veins all free. **Sori** along veins, without indusia.

Pityrogramma calomelanos (L.) Link., Handb. Gew. 3: 20. 1833; Holttum, Rev. Fl. Malaya 2: 593. f. 348. 1955; Shieh, Fl. Taiwan vol. 1. 2 nd ed.: 315. pl. 111. 1980; Tagawa & K. Iwats., Fl. Thailand 3(2): 193. 1985.- *Acrostichum calomelanos* L., Sp. Pl.: 1072. 1753.- *Pellaea calomelanos* (L.) Link, Fil., Sp.: 61. 1841; Bedd., Handb.: 104. 1969.

Rhizome short, erect, bearing a close tuft of erect fronds, densely covered with scales; scales bright brown, narrow, thin, entire, up to 3-4 mm long. **Stipes** up to 55 cm long, very dark purplish, polished, scaly on lower part, glabrous upwards, cover with with powder when young, towards the apex slightly grooved on the adaxial surface. **Lamina** bipinnate, oblong, with acuminate apex, about 65 by 22 cm, rachis glabrous, grooved on upper surface; lateral pinnae gradually smaller upwards; lower ones stalked, linear-subtriangular, acuminate to long tail at apex, up to 13 by 3 cm; pinna-rachis slender, grooved above; pinnules oblong to oblong-lanceolate, cuneate at base, acute to acuminate at apex, lobed or pinnatisect in larger ones, up to 25 by 3 mm; lobed oblanceolate or spathulate, oblique, acute and dentate at apical portion, texture subchartaceous, light green, glabrous, but coating with white waxy powder; vein free, pinnate in larger ones. **Sporangia** scattered throughout the lower surface, without any protection. **Fig. 6.50**

Thailand.- NORTHERN: Chiang Mai (Wang Tao), Mae Hong Son (Mae Sariang), Tak (Ban Musoe); SOUTH-EASTERN: Trat (Ko Chang); SOUTH-WESTERN: Kanchanaburi (wangka, Ban Kasi); PENINSULAR: Nakhon Si Thammarat (Khao Luang, Wat Khiriwong, Narathiwat (Bacho Falls), Yala (Bukit,

Betong, Bannang Sata), Phangnga (Khao Katha Khawam), Trang (Khao Chong), Satun (Khuan Kalong).

Distribution.- Pantropics (type from America); this may have been spread to the palaeotropics by man.

Ecology.- On open mountain slopes or along stream in Mixed deciduous forest at 100 m altitudes.

Vernacular.- Foen ngoen (เฟินเงิน), Foen thong (เฟินทอง) (General).

Uses.- Often cultivates as an ornamental plant.

Specimens examined.- BCU: Y. Yuyen 13, 110; P, Rachata 209; T. Boonkerd 476, 1024, 1214.

PARKERIACEAE

Devol, Fl. Taiwan vol. 1. 2 nd ed.: 129. 1980.

Aquatic ferns, **Rhizome** short, erect, bearing a tulf of fronds, scaly. **Stipes** fleshy, green. **Lamina** dimorphic, bipinnatifid to tripinnate; texture soft-papyraceous. **Sporangia** on veins except on raised costae of ultimate segment.

CERATOPTERIS

Brongn., Bull. Soc. Phil. 1821.

Rhizome short, with a few small scales. **Lamina** pinnately decompound, dimorphic; veins anastomosing. **Sporangia** elongate along the veins, occupying whole undersurface of fertile pinnules, protected by continuous reflexed margins.

Ceratopteris thalictroides (L.) Brongn., Bull. Soc. Phil. 1821: 186. 1822; Holttum, Rev. Fl. Malaya 2: 578. 1955; Bedd., Handb.: 123. f. 63. 1969; Devol, Fl. Taiwan vol. 1. 2 nd ed.: 129. pl. 43. 1980; Tagawa & K. Iwats., Fl. Thailand 3(2): 184. f. 14. 1. 1985.- *Acrostichum thalictroides* L., Sp. Pl.: 1070. 1753.

Aquatic ferns, **Rhizome** short, erect, bearing a tulf of fronds, scaly; scales fuscous, thin, entire, ovate and cordate at base. **Stipes** fleshy, green, up to 20 cm glabrous. **Lamina** dimorphic; **Sterile fronds:** bipinnatifid to tripinnate, oblong, usually shorter than fertile ones; rachis and pinna rachis like the upper part of stipe, green; ultimate lobes linear, acute at apex, glabrous; texture soft-papyraceous, green;

Fertile fronds: longer, up to 22 by 11 cm, more copiously devided; pinnules divided in to linear lobes; ultimate lobes up to 2.5 cm long and 1 mm broad, with reflexed edges, edges of the lamina of pinnules thin and translucent, reflexed to meet below, or towards the base of the pinnule to meet the raised midrib. **Sporangia** on veins except on raised costae of ultimate segment, solitary, large with short stalks. **Fig. 6.51**

Thailand.- NORTHERN: Chiang Mai (Ban Sin Khao, San Sai, Fang, Ban Yang), Mae Hong Son (Mae Sariang), Phitsanulok (Thung Salaeng Luang); EASTERN: Buri Ram (Ban Chum Saeng); CENTRAL: Pathum Thani (Rangsit), Bangkok; SOUTH-EASTERN: Chon Buri (Si Racha), Chanthaburi (Khlong Sabap), Trat (Huai Raeng, Ko Chang); SOUTH-WESTERN: Kanchanaburi (Sai Yok), Prachuap Khiri Khan (Bang Saphan); PENINSULAR: Surat Thani (Ban Don), Phattalung, Satun (Bukit Raya).

Distribution.- Warmer regions throughout the World (type from Ceylon).

Ecology.- An aquatic fern in light shade in Mixed deciduous forest at 150 m altitudes.

Vernacular.- Kut phao (กูดใบเล็ก) (Northern), Kha khaiat nam khem (ขาเขียดน้ำเค็ม) (South-eastern).

Specimens examined.- BCU: Y. Yuyen 201; T. Boonkerd 1270, P. Keosongsee 14; O. Thaithong et al. 17.

PTERIDACEAE

Shieh, Fl. Taiwan vol. 1. 2 nd ed.: 281. 1980.

Rhizome creeping or erect, covered with hairs or scales. **Lamina** varied form small to very large; veins free, or anastomosing with a row of costal areoles and sometime others also, without free veins in areoles. **Sori** elongate along margin of pinnae or sporangia covered the whole lower surface of fertile pinnae.

Key to the genera

1. Sporangia in linear sori along margin of fronds; veins pinnate or forming costal areoles **1. Pteris**
1. Sporangia not in sori, scattered all over lower surface; veins forming costal areoles **2. Stenochlaena**

1. PTERIS

L., Sp. Pl.: 1073. 1753.

Rhizome short, erect or creeping, scaly; scales concolorous or bicoloured with pale ferrugineous edges. **Stipes** distinctly grooved on upper surface. **Lamina** in most case bipinnatisect in opposite pairs, or in some cases simple, pinnate, tripinnate; veins pinnate, in some species with costal and costular areoles. **Sori** elongate along margin of pinnae or ultimate segment, indusiate; indusia formed by reflexed margin of lobed.

Key to the species

1. Pinnae deeply lobed, or each of the lowest pinnae with one or few branches near base
   2. Pinnae bipinnatisect, deeply lobed
      3. Veins anastomosing to form regular costal areoles; stipe stramineous, up to 30-40 cm long **1. P. biaurita**
      3. Veins free except those united apically by soral commisure, stipe deep green, up to 45-90 cm long **3. P. longipinnula**
   2. Pinnae imparipinnate, serrate at margin, the lowest pinnae with one branch **2. P. cretica**
1. Pinnae all simple, subentire at margin, basal pinnae not branched, lateral pinnae 3 cm broad **4. P. venusta**

1. Pteris biaurita L., Sp. Pl.: 1076. 1753; Holttum, Rev. Fl. Malaya 2: 407. f. 237. 1955; Shieh, Fl. Taiwan vol. 1. 2 nd ed.: 293. 1980; Tagawa & Iwats., Fl. Thailand 3 (2): 237. 1985.- *Campteria biaurita* (L.) Hook., Gen. Fil.: t. 65 A. 1841; Bedd., Handb.: 116. 1969.- *Pteris quadriaurita* var. *grevilleana* H. Christ, Bot. Tidsskr. 24: 106. 1901.- *Pteris repandula* Link, Fil. Sp.: 56. 1841.

Rhizome short, erect, covered with many slender roots, bearing a few fronds in a tuft, densely scaly at apex; scales oblong, up to 3 by 0.5 mm, bicoloured, the central portion dark brown, stiff, with pale yellow hairy edges. **Stipes** up to 30-40 cm long, stramineous and scaly at base. **Lamina** bipinnatisect, oblong, acute at apex, about 40-50 by 25-30 cm, pinnae subopposite to opposite, up to 8-9 pairs, straight, ascending, linear-lanceolate, broadly cuneate at base, gradually narrowing toward acuminate apex, up to 15-17 by 3 cm, deeply lobe to 5/6 way towards costa, basal pinnae bearing a long basiscopic pinnule just like lateral ones; ultimate segments oblong, falcate, rounded or moderated acute at apex, with a fairly broad intervening sinus, up to 5 mm broad, 2 cm long in lower portion; texture thin, green, glabrous; basal veinlets uniting with those of

opposite groups forming arches close to costa, bearing a few branching on posterior side, the other veinlets forked, all free. **Sori** marginal, usually continuous along segments except at bottom of sinus and at apex; indusia thin, pale. **Fig. 6.54**

Thailand.- NORTHERN: Chiang Rai (Mae Lao, Doi Tung, Mae Kok, Pang Kia,Doi Pacho), Chiang Mai (Doi Phahom Pok, Doi Chaing Dao, Wang Tao, Doi Suthep, Ban Mae Kom, Ban Nong Lu, Ban Yang), Lamphun (Doi Khun Tan), Phetchabun (Phu Miang), Tak (Huai Krasa, Maesot, Doi Musoe, Lan Sang); NORTH-EASTERN: Loei (Phu Luang, Phu Kradueng); CENTRAL: Nakorn Nayok (Khao Yai); SOUTH-EASTERN: Chon Buri (Si Racha), Chanthaburi (Khao Sabap), Trat (Ko Chang); SOUTH-WESTERN: Kanchanaburi (Wang Ka, Sai Yok, Kroeng Kawia); PENINSULAR: Surat Thani (Kao Luang), Nakhon Si Thammarat (Thung Song), Phangnga (Khao Thong Lang), Trang(Khao Chong).

Distribution.- Pantropic (type from Tropical America).

Ecology.- On mountain slopes in light shade in Mixed deciduous forest to Hill evergreen forest at various altitudes.

Vernacular.- Kut hang khang (กูดหางค่าง) (Northern) ; Phak kut kon khang phaya nak (ผักกูดขนคางพญานาค) (South-western).

Specimen examined.- BCU: Y. Yuyen 4; P. Rachata 42, 271; T. Boonkerd 714, 592.

2. <u>Pteris cretica</u> L., Mant. Pl.: 130. 1767; Bedd., Handb.: 106. 1969; Shieh, Fl. Taiwan vol. 1. 2 nd ed.: 294. 1980; Tagawa & K. Iwats., Fl. Thailand 3(2): 255. 1985.

Rhizome short, erect, bearing a tuft of fronds, scaly at apex; scales linear, about 5 mm long, entire, brown. **Stipes** stramineous in sterile frond and castaneous to deep purple in fertile frond, usually 20 cm or sometimes up to 30-50 cm long, those of fertile frond longer. **Lamina** more or less dimorphic, imparipinnate, about 30-35 by 15-20 cm; lateral pinnae up to 5 pairs, narrowing towards base, caudately long-acuminate at apex, serrate at margin, sessile or shortly stalked at base, costa and rachis raised on lower surface and grooved on uppper surface, up to 18-25 by 2 cm in sterile and 25 by 1 cm in fertile ones, basal lateral pinnae bearing one branches; texture papyraceous to subcoriaceous, light green to deep green, glabrous; veins ascending,

forked, all free. **Sori** continuous from base nearly to apex of pinnae; indusia firm, brown. **Fig. 6.55**

Thailand.- NORTHERN: Chiang Rai, Chiang Mai (Doi Chiang Dao, Doi Suthep), Lampang; NORTH-EASTERN: Phetchabun (Phu Miang), Khon Kaen; SOUTH-EASTERN: Chon Buri (Si Racha), Chanthaburi (Khao Soi Dao); PENINSULAR: Surat Thani (Ko Tao, Ban Don), Krabi (Khao Phanom Bencha), Yala (Betong).

Distribution.- Tropics and subtropics throughout the world (type from Crete).

Ecology.- On mountain slopes in Tropical evergreen forest at 800 m altitudes.

Vernacular.- Kut Phi Sue (กูดผีสือ) (Northern).

Specimen examined.- BCU: Y. Yuyen 30; BKF: E. Hennipman 3055, K. Iwatsuki & N. Fukuoka T7103, T. Smitinand 5548.

3. Pteris longipinnula Wall. ex J. Agardh, Rec. Pterid.: 19. 1839; Holttum, Rev. Fl. Malaya 2: 404. 1955; Bedd., Handb.: 112. 1969; Tagawa & K. Iwats., Fl. Thailand 3 (2): 239. 1985.

Rhizome short, suberect, scaly at apex; scales narrowly, distinctly bicolored, the central portion dark brown, stiff, marginal portion pale brown, thin, composed of quadrangular cells and decaying from margin. **Stipes** green, drying stramineous, slightly castaneous to purplish near base, about 45-90 cm long, slightly grooved above and terete below, glabrous. **Lamina** bipinnatisect, oblong-ovate to ovate, acute at apex, about 40-60 by 20-25 cm; rachis hairy in grooves; 2-4 pairs of similar lateral pinnae, all nearly equal in size and form, with short stalks 3-10 mm long, oblong-lanceolate, broadly cunate at base, the base decurrent to stalks, caudate at apex with apical segment up to 25-35 by 5-6 mm, up to 16-21 by 5-7 cm at middle portion; costa green, stramineous in dry specimens, grooved, bearing sparsely slender spines; ultimate segment 15-20 pairs, narrowly elliptic, falcate, rounded at apex, up to 30-55 by 5-10 mm, the lower basal ones more or less longer than upper ones, edges entire, thickended; veins simple or more commonly forked, basal portion ones springing directly from costa. **Sori** linear, along margin of ultimate segments; indusia up to 0.5 mm broad, thin but firm, entire. **Fig. 6.52**

Thailand.- PENINSULAR: Surat Thani (Ban Don), Yala (Bannang Sata).

Distribution.- S. India, Malesia (type from Malaya).

Ecology.- Terrestrial near marshes in Tropical evergreen forest at 800 m altitudes.

Specimen examined.- BCU: Y. Yuyen 72; T. Boonkerd 1483.

4. Pteris venusta Kunze, Bot. Zeit. 6: 195. 1848; Tagawa & K. Iwats., Fl. Thailand 3 (2): 256. 1985.- *Pteris pellucida* auct. non C. Presl: Bedd., Handb.: 106. 1969.

Rhizome short, creeping or ascending, bearing close fronds, densely scaly at apex; scales linear, up to 5 mm long, brown or dark brown to nearly black with paler edge, entire. **Stipes** brown and scaly at base, stramineous, castaneous above, glabrescent, up to 35-60 cm long. **Lamina** imparipinnate, oblong, up to 40 by 30 cm; rachis stramineous or castaneous, winged in upper part, puberulous; lateral pinnae 4 pairs, never branching, sessile or shortly stalked in lower ones, falcate, gradually narrowing toward cunate base, caudate with long tail at apex, margin subentire, up to 25 by 3 cm, terminal pinnae like the lower lateral pinnae but straight; texture chartaceous, veins simple or forked, all free, visible on both surfaces. **Sori** continuous along margin of pinnae except at base and toward apex; indusia thin but firm, pale brown. **Fig. 6.53**

Thailand.- NORTHERN: Chiang Rai (Doi Tham Tu Pu), Chiang Mai (Doi Chiang Dao, Doi Saket, Doi Suthep, Doi Inthanon), Lampang, Lamphun (Khun Tan), Tak (Lan Sang, Khao Phra Wo), Phitsanulok (Thung Salaeng Luang); NORTH-EASTERN: Loei (Phu Luang, Phu Kradueng), Khon Kaen (Kranuan); EASTERN: Nakhon Ratchasima (Khao Yai); SOUTH-EASTERN: Chon Buri (Si Racha, Hup Bon), Prachin Buri (Ban Bueng Hills), Chanthaburi (Khao Soi Dao, Pong Nam Ron); SOUTH-WESTERN: Kanchanaburi (Sai Yok, Kroeng Kawia, Song Tho).

Distribution.- N. India to Malesia (type from Java).

Ecology.- On rather dry mountain–slopes in Mixed deciduous forest at 120 m altitudes.

Specimen examined.- BCU: Y. Yuyen 163; T. Boonkerd 63, 115, 448, 593.

2. STENOCHLAENA

J. Smith, J. Bot. 3: 401. 1841.

Epiphytic plants; **Rhizome** creeping, green, scaly only at apex, scales peltate, with uneven margin. **Stipes** not jointed to rachis. **Lamina** simply pinnate, distinctly dimorphic; lateral pinnae jointed to rachis, sterile ones toothed at margin; fertile ones narrow, linear, with sporangia covering the whole undersurface; texture coriaceous; veins forming costal areoles, other veins free.

Stenochlaena palustris (Burm. f.) Bedd., ferns Br. Ind. Suppl.: 26. 1876; Holttum, Rev. Fl. Malaya 2: 412. f. 241. 1955; Bedd., Handb.: 421. f. 253. 1969; Tagawa & K. Iwats., Fl. Thailand 3 (2): 259. 1935.- *Polypodium palustre* Burm. f., Fl. Ind.: 234. 1768.

Rhizome long–creeping, climbing on tree-trunks, green, scaly at apex; scale peltate at base, gradually attenuate at apex, with uneven margin, about 3 by 1 mm, dark brown at central portion, paler margin. **Stipes** up to 10-20 cm long, sparsely scaly at base. **Lamina** imparipinnate, about 50-60 cm. long, bearing pinnae up to 9 pairs and a similar terminal pinna, alternate at lower portion and subopposite at upper portion; sterile pinnae shortly stalked, articulate, about 15-16 by 2.5-3 cm, but variable in size, acuminate at apex, broadly cuneate at base, pellucid at sharply and irregularly serrate margin; texture papyraceous to coriaceous; shining above, the lower paler than the upper; veins simple or forked, forming a row of narrow costal areoles. **Fig. 6.56**

Thailand.- NORTH-EASTERN: Loei (Ban na Luang); CENTRAL: Bangkok; SOUTH-EASTERN; Chanthaburi (Makham, Pong Nam Ron), Trat (Ko Chang); PENINSULAR: Surat Thani (Ban Don, Ko Tao), Nakhon Si Thammarat (Khao Luang), Krabi (Ao Luk), Trang (Khao Chong).

Distribution.- N. and S. India (type), Indochina, throughout Malesia and Polynesia to Australia.

Ecology.- Climbing on tree-trunks along stream in Mixed deciduous forest at 150 m altitudes.

Vernacular.- Prung suan (ปรงสวน), Phak kut daeng (ผักกูดแดง), Phak kut mon (ผักกูดมอญ), Phak yot daeng (ผักยอดแดง) (Central); Pa ku ma ding (ปะกูมาดิง)

(Malay/Penninsular); Lamtheng (ลำเท็ง) (Penninsular); Lam matheng (ลำมะเท็ง)(Eastern, South-western).

Note.- Fertile fronds absent.

Specimen examined.- BCU: Y. Yuyen 123; T. Boonkerd 665, 676, 745.

VITTARIACEAE

Devol, Fl. Taiwan vol. 1. 2 nd ed.: 231. 1980.

Epiphytic or lithophytic ferns; **Rhizome** creeping, short. **Lamina** simple, tuft; veins anastomosing, forming elongate areoles. **Sori** linear; sporangia elongate along the margin, or dichotomously forking veins; superficial or in soral grooves, mixed with paraphyses, filiform or club-shape, simple or branched.

Key to the genera

1. Fronds broad, not grass-like, costa incompleate; sori usually in more than two row, often reticulate **1. Antrophyum**
1. Fronds narrow, grass-like, costa present; sori in one or two rows along margin **2. Vittaria**

1. ANTROPHYUM

Kaulf., Enum.: 197. 1824.

Rhizome short-creeping, densely covered with clathrate scales. **Lamina** simple, broadly lanceolate or broader; veins forming large elongate areoles. **Sori** elongate along veins, sometime reticulate.

Antrophyum callifolium Blume, En. Pl, Jav.: 111. 1828; Holttum, Rev. Fl. Malaya 2: 605.f. 356.1955; Tagawa & K. Iwats., Fl. Thailand 3(2): 221.1985.- *Antrophyum reticulatum* auct. non (Forst.) Kaulf.: Bedd., Handb.: 401. f. 235. 1969.- *Antrophyum semicostatum* auct. non Bl.: Bonap., Not. Pterid. 14: 63. 1923.- *Antrophyum* sp.: Holttum, Dansk Bot. Ark. 20: 34. 1961.

Rhizome short-creeping, bearing a few to several fronds in a tuft, scaly at apex; scales narrowly subtriangular, gradually narrowing from base towards long- tailed apex, shallowly toothed at margin, up to 5 by 0.5 mm, blackish. **Stipes** short, indistinctly merging with the basal portion of fronds or widening gradually from a

short narrowly winged stalk, scaly at base. **Lamina** oblong-lanceolate, gradually narrowing towards both end, acuminate apex, attenuate at base, up to 19-22 by 2-3 cm; texture papyraceous; pale green; midrib distinct only near the base, veins more or less distinct, forming narrow longitudinal areoles throughout. **Sori** in shallow grooves along anastomosing along veins, usually on the upper part of lowersurface; paraphyses filamentous, long, brown, numerous. **Fig. 6.58**

Thailand.- NORTHERN : Chiang Mai (Doi Suthep, Chiang Mai, Mae Tang, Lamoo), Tak (Huai Krasa); NORTH-EASTERN: Nong Khai; Loei (Phu Luang, Phu Kradueng, Khao Huai Khae); CENTRAL: Nakhon Nayok (Khao Yai , Nang Rong Falls); SOUTH-EASTERN: Chanthaburi (Khao Soi Dao, Khao Sabap), Trat (Ko Chang); SOUTH–WESTERN: Kanchanaburi (Khao Sakan, Sung Tho); PENINSULAR: Chumphon (Tha Ngo, Lang Suan, Tako, Sapli), Surat Thani (Ko Tao, Ban Don, Ko Phangan), Nakhon Si Thamarat (Khiriwong, Khao Luang, Thung Song), Narathiwat (Sg. Padi), Phangnga (Thap Put), Phuket, Trang (Ko Chang), Satun, Yala (Bannang Sata).

Distribution.- Widely known from the tropics of the old World (type from Java), although the exact boundary is not clear.

Ecology.- On muddy rocks in Dry evergreen forest at 400 m altitudes.

Specimen examined.- BCU: Y. Yuyen 9; E. Hennipman 3738; J. F. Maxwell 86-1012; Tagawa et al. T376, T1836, T1893.

2. VITTARIA

J. E. Smith, Mém. Acad. Turin 5: 413. pl. 9. f. 5. 1793.

Rhizome short-creeping. **Lamina** simple, linear; veins forming areoles. **Sori** in a single row at each side of costa, dorsal or in marginal flaps; paraphyses usually abundant.

Key to the species

1. Sori marginal, immersed in grooves
   3. Fronds 33-37 cm long, up to 6 mm broad — **2. V. ensiformis**
   3. Fronds 1-11 cm long, up to1.5 mm broad — **3. V. sikkimensis**
1. Sori intra marginal, superficial — **1. V. amboinensis**

1. Vittaria amboinensis Fée, 3 me Mém.: 14. t. 1. f. 1. 1852; Bedd., Handb.: 407. 1969; Tagawa & K.Iwats., Fl. Thailand 3(2) : 226. f. 17. 6. 1985.- *Vittaria scolopendrina* auct. non (Bory) Thwait.: Holttum, Dask Bot. Ark. 20: 34. 1961.

Rhizome short creeping, about 3-5 mm diam, bearing a mass of roots, densely scaly throughout; scales subtriangular, long tailed at apex, clathrate, translucent, minutely toothed throughout, up to 5 by 0.2 mm, dark brown to blackish. **Stipes** distinct, up to 3-10 cm long, dark castaneous on the lower portion, very narrowly winged almost to the very base. **Lamina** simple, linear-lanceolate, gradually narrowing towards acuminate apex, gradually narrowing downwards into wings of stipe, up to 12-35 cm long including stipe, 0.5-1.5 cm broad, margins flat or sligtly recurved; texture papyraceous; costa distinctly raised on lower surface, grooved above; veins hidden, grabrous. **Sori** superficial, submarginal, the submarginal laminar portion less than 1 mm wide, throughout the margin of frond except for the apex and lowest portion. **Fig. 6.59, 6.60**

Thailand.- NORTHERN; Chiang Mai (Doi Suthep), Tak (Ban Musoe); NORTH-EASTERN: Loei (Phu Luang, Phu Kradueng); EASTERN: Nakhon Ratchasima (Khao Khieo); SOUTH-EASTERN: Chanthaburi (Khao Soi Dao); PENINSULAR: Krabi (Phanom Bencha), Trang (Khao Chong).

Distribution.- Sikkim, Myanmar, Indochina, Amboina (type) and Indonesia.

Ecology.- On tree-trunks usually in Hill evergreen forest at 1000-1060 m altitudes

Specimen examined.- BCU: Y. Yuyen 47, 94; BKF: E. Hennipman 3673, 9584; Tagawa et al. T945; T. Smitinand 11914.

2. Vittaria ensiformis Sw., Ges. Nat. Fr. Berl. Neu. SC. Chr. 2: 134. t. 7. f. 1. 1799; Holttum, Rev. Fl. Malaya 2: 613. f. 359. 1955; Tagawa & K.Iwats., Fl. Thailand 3(2) : 223. 1985.- *Vittaria hainamensis* C. Chr. ex Ching, Sinensis 1: 182. pl. 1. 1931.

Rhizome short-creeping, slender, 2 mm diam, bearing fronds close together; densely covered with a mass of roots, scaly at apex; scales narrow, gradually narrowing towards tailed apex, dark brown to nearly black, clathrate, minutely toothed at margin, up to 5 by 0.3 mm. **Stipes** usually indistinct, narrowly winged throughout. **Lamina** linear, up to 33-37 by 6 mm; texture subcoriaceous; green to deep green, costa

more or less distinct on the upper portion, indistinct below or hardly visible on the lower portion, other veins indistinct, margin sometimes inrolled. **Sori** immersed in deep grooves along margin, usually elongate along margin; paraphyses filamentous, numerous, brown. **Fig. 6.57**

Thailand.- SOUTH-EASTERN: Chanthaburi (Makham), Trat(Huai Raeng, Ko Chang); CENTRAL: Bangkok; PENINSULAR: Krabi (Ko Pu), Surat Thani (Ko Tao, Ban Don), Phangnga (Khao Suang), Nakhon Si Thammarat (Khao Luang), Trat (Khao Chong, Khao Khao), Phuket, Satun (Khuan Kalong, Boriphat Falls), Pattani (Khok Pho, Ban Sai Khao).

Distribution.- Tropics of the Old World (type from Mascarene Islands), the boundary is not certain.

Ecology.- On tree-trunks usually in Dry evergreen forest at 250 m altitudes.

Spcimen examined.- BCU: Y. Yuyen 63, 115, 129; T. Boonkerd 677, 688, 692, 1203.

3. Vittaria sikkimensis Kuhn, Linnaea. 36: 66. 1866; Bedd., Handb.: 406. f. 239. 1969; Tagawa & K.Iwats., Fl. Thailand 3(2) : 224. f. 17. 5. 1985.

Rhizome short-creeping, slender, bearing a cluster of fronds; densely scaly throughout; scales linear, gradually narrowing towards hair-pointed apex, up to 3 mm long, greenish-brown, clathrate, toothed at margin. **Stipes** indistinct, winged throughout. **Lamina** simple, very narrow, linear, gradually narrowing towards long acuminate apex, narrowing downs, up to 1-11 by 1.5 mm; texture subcoriaceous; deep green; costa indistinct, margin flat or slightly inrolled; veins anastomosing to form narrow areoles. **Sori** immersed in distinct grooves near the margin of fronds, occupying almost the whole margin except near apex and lowest portion. **Fig. 6.61**

Thailand.- NORTHERN: Chiang Mai (Doi Suthep, Doi Inthanon), Phetchabun (Phu Miang): NORTH-EASTERN: Loei (Phu Luang, Phu Kradueng).

Distribution.- Sikkim (type), Yunnan and Tonkin.

Ecology.- On moist rocks in Hill evergreen forest at 1050 m altitudes.

Spcimen examined.- BCU: Y. Yuyen 202; P. Rachata 283.

ORDER BLECHNALES

ASPLENIACEAE

Devol and Kuo, Fl. Taiwan vol. 1. 2 nd ed.: 476. 1980.

Rhizome creeping or erect, terrestrial, climbing or epiphytic; scales usually small, dark and clathrate. **Lamina** simple, pinnate or more finely dissected, with free veins. **Sori** usually rather long, along on one side of the veins, protected by narrow indusium attached along the vein and opening normally towards the midrib of the leaflet.

ASPLENIUM

L., Sp. Pl.: 1078. 1753.

Rhizome short, erect or long creeping; scales clathrate, glabrous. **Lamina** simple to pinnately compound; veins free, of uniting at apex to form submarginal veins. **Sori** elongate along veins, superficial, with indusia of the same shape.

Key to the genera

1. Frond simple
   2. Veins anastomosing at margin joining the apices of veinlets
      3. Frond up to 12-14 cm broad, gradually narrowing towards at base; sori close, about 0.5 mm apart, usually reaching less than halfway from costa **5. A. nidus**
      3. Frond up to 10 cm broad, long attenuate at base; sori 0.5 mm apart, occupying 3/4 of the length of veins **9. A. simonsianum**
   2. Veins all free; frond up to 1.5-2 cm broad, with shallow serration at margin in upper part **8. A. scortechinii**
1. Frond pinnate
   4. Frond simply pinnate
      5. Rhizomes erect or short creeping
         6. Costa grooved above; rachis not viviparous
            7. Pinnae stipitate, lobed usually to halfway or more
               8. Pinnae subtriangular to falcate, up to 8 cm long, lobed nearly to costa
                  9. Pinnae up to 2.5 cm wide; stipe blacked to dark brownish-purple, scaly throughout **7. A. perakense**
                  9. Pinnae up to 1 cm wide; stipe dark purplish, polished, glabbrescent **4. A. falcatum**
               8. Pinnae rhomboid, up to 3.5-4.5 cm long, lobed halfway to costa **11. A. yoshinakae**
            7. Pinnae sessile, shallow lobed, scale bearing projection **3. A. crinicuale**

6. Costa usually raised; frond up to 3-4 cm wide, rachis viviparous **6. A. normale**

5. Rhizome long creeping; pinnae subdimidiate at acroscopic base

10. Sori more than 3-4 mm long, on middle or basal part of veins; frond up to 4-5 cm wide, oblong-lanceolate in outline **10. A. unilaterale**

10. Sori up to 1.5-2 mm long, confined to lobes **1. A. Cheilosorum**

4. Frond tripinnate; pinnae 10-15 cm long; stipe purplish to nearly black, shining, not gemmiferous **2. A. confusum**

1. Asplenium cheilosorum Kunze ex Mett., Abhandl. Senckenb. Naturf. Ges. 3:177. t. 5. f. 12-13. 1859; Holttum, Rev. Fl. Malaya 2: 435. f. 253. 1955; Devol and Kuo, Fl. Taiwan vol. 1. 2 nd ed.: 481. 1980; Tagawa & K. Iwats., Fl. Thailand 3(2): 279. f. 22. 2. 1985.- *Asplenium heterocarpum* Wall. ex Hook., Sp. Fil. 3: 132. t. 175. 1860; Bedd., Handb.: 153. f. 77. 1969.

Rhizome slender, creeping, bearing two rows of alternate fronds closely on dorsal surface; scales gradually narrowing from the base towards long, dark, entire, up to 3 by 0.5 mm, clathrate, the cell-walls very thick. **Stipes** 7-12 cm long bearing scales at the base only, purple, polish, groove above; rachis similarly coloured, glabrous, grooved above. **Lamina** 1-pinnate, narrowly lanceolate in outline, subtruncate at base, attenuately acuminate at apex, 20-25 by 4 cm; pinnae up to 40 or more pairs, subquadrangular, dimidiate, the lower half very narrow, thus the midrib close to entire lower margin, rounded at apex, truncate at acroscopic base, lobes to 1/5 way on upper margin, lobes rounded or forked at apex, about 1-1.5 mm broad, usually a lobe placed on each apical portion of lower margin, up to 2 by 7 mm, a few lower pairs slightly reduced or reflex, shortly stalked; texture thin, pale green; veins distinct, all free, the lateral vein once forked, the two branches passing one to each tooth of lobe. **Sori** confined to lobes, one or rarely two on each lobe, 1.5-2 mm long; indusia thin, opening outwardly. **Fig. 6.62, 6.63**

Thailand.- NORTHERN: Chiang Rai (Doi Phacho), Chiangmai (Doi Suthep, Doi Inthanon, Doi Hau Mot), Mae Hong Son (Mae La Noi), Phetchabun (Phu Miang); NORTH-EASTERN: (Khao Soi Doa); PENINSULAR: Nakhon Si Thammarat (Khao Luang).

Distribution.- Ceylon (type), S. India, E. Himalayas, S. China, Myanmar, Indochina, Malaysia, Borneo, Philippines, Taiwan and Northern to Southern edge of Japan.

Ecology.- On moist muddy rocks or terrestrial on wet sandy slopes usually along streams in Hill evergreen forest at 1050 m altitudes.

Specimens examined.- BCU: Y. Yuyen 41; BKF: K. Iwatsuki & N. Fukuoka T33690; M. Tagawa, K. Iwatsuki & N. Fukuoka 2667 .

2. Asplenium confusum Tardieu & Ching, Not. Syst. 5: 148. pl. 4. f. 3. pl. 7. 1936; Tagawa & K. Iwats., Fl. Thailand 3(2): 289. 1985.- *Asplenium laserpitiiforme* auct. non Lamk.: H. Christ, Bot. Tidsskr. 24: 107. 1901.

Rhizome short, ascending, bearing a tulf of fronds, densely scaly; scales narrow, gradually narrowing towards hair-pointed apex, about 12 by 1 mm, entire, greyish to dark brown, criped. **Stipes** about 20-30 cm long, polished dark purple or nearly black, grooved above. **Lamina** tripinnate, elliptic to oblong-subtriangular, acuminate, 30-35 by 10-25 cm, rachis grabrous, grooved above; lower pinnae 2-4 cm from the next ones, ascending, oblong-subtriangular, acute at apex, cuneate to subtruncate at base, gradually narrowing and bending up wards caudately acuminate apex, stalked about 5 mm, 10-15 by 5-7 cm; larger pinnules stalked, oblong-subtriangular, acute at apex, cuneate at base, pinnatifid to pinnate, up to 3 by 1.5 cm; ultimate segment (or secondary pinnules) spathulate, round and toothed at apex, cuneate and sessile at base, up to 10 by 5 mm, sometimes lobed to half-way; texture papyraceous to coriaceous, green; veins raised on both surfaces, dichotomously brached. **Sori** up to 5 mm long, usually nearly to midrib, close together but rarely confluent; 1-4 for each lobed; indusia thin but firm, persistent. **Fig. 6.68**

Thailand.- NORTHERN: Phitsanulok (Thung Salaeng Luang), Tak (Mae Sot, Huai Krasa); NORTH-EASTERN: Loei (Phu Luang, Phu Kradueng); EASTERN: Buri Rum (Khao Krap); SOUTH-EASTERN; Chon Buri (Si Racha), Prachin Buri (Ban Ban Hills), Chanthaburi (Khao Sabap), Trat (Ko Chang); SOUTH-WESTERN; Prachuap Khiri Khan; PENINSULAR: Chumpon (Ban Krayae), Surat Thani (Ko Tao, Khlong Bakatae, Ko Samui, Ban Don), Phangnga (Pulao Tiban).

Distribution.- Indochina (type).

Ecology.- In crevice of cliffs or on mossy tree-trunks or often on root mass of *Asplenium nidus* in Tropical evergreen forest and Hill evergreen forest at 820-1050 m altitudes.

Vernacular.- Kaprok hang maeo (กะปรอกหางแมว) (South-eastern).

Specimens examined.- BCU: Y. Yuyen 36, 64, 153, 178; T. Boonkerd 133, 174 .

3. Asplenium crinicaule Hance, Ann. Sci. Nat. V. 5: 254. 1866; Bedd., Handb.: 150. 1969; Tagawa & K. Iwats., Fl. Thailand 3(2): 284. 1985.- *Asplenium pellucidum* auct. non Lamk.: H. Christ, Bot. Tidsskr. 24: 108. 1901.

Rhizome short, erect, bearing a close group of fronds; densely scaly; scales gradually narrowing from base towards hairy-pointed apex, up to 7 by 0.5 mm, the margin bearing irregular and sparsely projection, brown to black. **Stipes** usually up to 10 (rarely up to 15) cm long, dark brownish-purple to nearly black, bearing narrow scales throughout, grooved above. **Lamina** 1-pinnate, narrowly lanceolate, gradually narrowing towards both ends, acuminate at apex, usually about 28-30 by 6-8 cm; fairly variable in size; rachis with narrow hair-like scales throughout, lateral pinnae 25-30 pairs; sessile, narrowly subtriangular to elliptic, falcate or nearly patent, acute at apex, auricled at acroscopic base, narrowly cuneate at basiscopic base, the middle largest ones 2.5-5.5 by 0.7-1.5 cm, indistinctly lobed, lobes with a few teeth, each containing a single veinlet; texture softly chartaceous, deep green. **Sori** up to 5 mm long, crescent-shaped along the posterior veinlets, opening towards posterior. **Fig. 6.64**

Thailand.- NORTHERN: Chiang Rai (Doi Phacho), Chiang Mai (Doi Chiang Dao, Doi Suthep), Lampang (Mae Tai), Lamphun (Doi Khun Tan); NORTH-EASTERN: Loei (Phu Luang, Phu Kradueng); CENTRAL: Nakon Nayok (Khao Yai); SOUTH-EASTERN; Chantaburi (Khao Sabap), Trat (Ko Chang); SOUTH-WESTERN: Kanchanaburi (Sai Yok), Prachuap Khiri Khan (Huai Yang).

Distribution.- India, S. China (type) and Indochina.

Ecology.- Terrestrial fern or on muddy rocks in Dry evergreen forest, Tropical evergreen forest and Hill evergreeen forest at 300-1050 m altitudes.

Specimens examined.- BCU: Y. Yuyen 3; T. Boonkerd 257, 1390; BKF: J. F. Maxwell 95-554; M. Tagawa et al T9247.

4. Asplenium falcatum Lam., Enc. 2: 306. 1786; Bedd., Handb.: 150. 1969; Tagawa & K. Iwats., Fl. Thailand 3(2): 284. 1985.- *Asplenium adiantoides* (L.) C. Chr., Ind. Fil.: 99. 1905; Holttum, Rev. Fl. Malaya 2: 431. f. 250. 1955; Devol and Kuo, Fl. Taiwan vol. 1. 2 nd ed.: 478. 1980.

Rhizome short-creeping, bearing a tuft of fronds, scales gradually narrowing towards long-acuminate apex, about 3 by 0.5 mm, dark brown to black. **Stipes** rather slender, up to 22 cm long, dark purplish, scaly or grabrescent. **Lamina** simply pinnate, up to 18-30 by 9-12 cm, oblong to narrowly oblong-subdeltoid, imparipinnate; pinnae falcate 15-18 pairs, stalks less than 5 mm long, the upper sessile, up to 8 by 1 cm, broadly cuneate at the base on the acroscopic side, narrowly cuneate on the basiscopic side, narrowed gradually from the widest part near the base to the long acuminate apex, distinctly single oblique teeth 1/3 way towards costa at margin; texture subcoriaceous, deep green; vein more or less visible, forming narrow angles with costa. **Sori** up to 7 by 1 mm closed to mibrib, often almost from base to near apex of the veins; indusia herbaceous, open to posterior side. **Fig. 6.65**

Thailand.- EASTERN: Buri Rum (Khao Luang); PENINSULAR: Chumpon (Thap Li), Nakhon Si Thammarat (Thung Song), Phangnga (Thap Put, Takua Thung).

Distribution.- Old world tropics (type from Mauritius).

Ecology.- On mossy tree-trunks or on mossy rocks in Hill evergreen forest at 1050 m altitudes.

Specimens examined.- BCU: Y. Yuyen 93; BKF: M. Tagawa et al T1496, T6804.

5. Asplenium nidus L. var. **nidus**, Sp. Pl.: 1079. 1753; Holttum, Rev. Fl. Malaya 2: 419. 1955; Devol and Kuo, Fl. Taiwan vol. 1. 2 nd ed.: 485. 1980; Tagawa & K. Iwats., Fl. Thailand 3(2): 266. 1985.- *Thamnopteris nidus* (L.) C. Presl, Epim.: 68. 1849; Bedd., Handb.: 137. 1969.

Rhizome short, stout, erect or ascending, bearing a rossett of fronds, usually with a mass of root on which are growing various epiphytes, scaly at apex; scales ovate-oblong, brown to darker, up to 2 cm long, 3 mm broad, clatharte. **Stipes** short, indistinct, stramineous to dark, 2-6 cm long. **Lamina** simple, up to 130 cm or more long, 12-14 cm broad, linear, broadest at middle, gradually narrowing towards both apex and base; texture coriaceous, grass-green in colour when living, paler below, glabrous; midrib raised on upper surface, flat below; veins one or rarely twice forked, the first forking near midrib and then running parallel, uniting at apex to form submarginal veins about 0.5 mm inside leaf margin. **Sori** elongate along veins, extending from near midrib halfway to the margin, usually on every vein; indusia about 0.5 mm broad, with space of 0.5 mm or wider between. **Fig. 6.66**

Thailand.- NORTHERN: Chiang Rai (Doi Phacho), Chiang Mai (Doi Chiang Dao, Ban Du, Doi Suthep), Lampang; NORTH-EASTERN: Loei (Phu Luang, Phu Kradueng), Nong Khai (Nong Khai Ploi); CENTRAL: Saraburi (Muak Lek); SOUTH-EASTERN; Chon Buri (Si Racha); SOUTH-WESTERN: Kanchanaburi (Sai Yok, Wangka, Khao Nam Tok); PENINSULAR: Surat Thani (Ko Tao, Ko Phu), Nakhon Si Thammarat (Khao Luang).

Distribution.- Throughout the Old World tropics (type from Java).

Ecology.- Usually on mountain slopes or on tree-trunks or on muddy rocks in Dry evergreen forest or in light shade in Tropical evergreen forest and Hill evergreen forest at various altitudes.

Vernacular.- Katae tai hin (กะแตไต่หิน) (North-eastern); kaprok hualong (กะปรอกหัวลง), kaprok hang sing (กะปรอกหางสิงห์) (South-eastern).

Specimens examined.- BCU: Y. Yuyen 122; P. Rachata 259; T. Boonkerd 1094.

6. <u>Asplenium</u> <u>normale</u> D. Don, Prod. Fl. Nepal.: 7. 1825; Holttum, Rev. Fl. Malaya 2: 436. f. 254. 1955; Bedd., Handb.: 144. 1969; Shieh, Fl. Taiwan vol. 1. 2 nd ed.: 486. 1980; Tagawa & K. Iwats., Fl. Thailand 3(2): 280. 1985.

Rhizome short, erect, bearing a close group of stipes, scaly; scales gradually narrowing from base towards hair-pointed apex, up to 2 by 1 mm, bicoloured, the central portion black, with longitudinal cells, the edges brown to dark-brown. **Stipes** deep castaneous to neary black, more or less polished, glabrescent, up to 8-12 cm long, usually about 10 cm long; rachis as stipes, narrowly grooved on the upper surface. **Lamina** pinnate, lanceolate to narrower, slightly narrowing at base, gradually narrowing upwards, cuadately acuminate at apex, up to 30-40 by 3-4 cm; rachis wingless throughout, viviparous; lateral pinnae up to 42 pairs; lowest pinnae hardly reduced but somewhat more distant and pointing downwards, upper pinnae gradually reduced, pinnae sessile, spreading, close, patent or slightly reflexed, oblong, rounded at apex, lobed to 1/5 way on both margins, narrowly cuneate at basiscopic base, auricled and truncate at acroscopic base, about 15 by 6 mm; midrib rarely viviparous; texture thin, green; veinlets simple or forked, not running to the very top of lobes. **Sori**

up to 3 mm long often one on the auricle and few orthers on the distal part of the pinna, rarely on all veins; indusia thin. **Fig. 6.70**

Thailand.- NORTHERN: Chiang Mai (Doi Khun Huai Pong), Mae Hong Son (Khun Maelan); NORTH-EASTERN: Phetchabun (Phu Miang), Loei (Phu Luang, Phu Kradueng); CENTRAL: Nakon Nayok (Khao Yai); SOUTH-EASTERN; Chantaburi (Khao Soi Dao; PENINSULAR: Krabi (Khao Phanom Bencha), Nakhon Si Thammarat (Khao Luang), Songkhla (Khao Khieo).

Distribution.- Old World tropics throughout, north to Himalayas (type) and Japan.

Ecology.- Terrestrial on humus-rich slopes or in crevices of cliffs in Tropical evergreen forest at 980 m altitudes.

Specimens examined.- BCU: Y. Yuyen 79; C. Khunwasi 47; T. Boonkerd 1258.

7. Asplenium parakense B. Mathew & H. Christ, J. L. Soc. Bot. 39: 214. 1909; Holttum, Rev. Fl. Malaya 2: 429. f. 248. 1955; Tagawa & K. Iwats., Fl. Thailand 3(2): 286. 1985.

Rhizome short, suberect, bearing a tuft of fronds, densely scaly at apex; scales gradually narrowing from base towards apex, entire, up to 8 by 1 mm at base, dark brown. **Stipes** black to dark brownish-purple, scaly throughout, 14-28 cm long, deeply grooved above. **Lamina** pinnate, narrowly oblong, long acuminate at apex, up to 30-42 by 11-15 cm, rachis like the upper part of stipe, scaly with narrow scales; pinnae 15-20 pairs, distinctly stalked, middle ones the largest, ascending, narrowly subtriangular or falcate, caudately acuminate at apex, auricle at acroscopic and cuneate at basiscopic base, lobed nearly to costa, largest pinnae to about 8 by 2.5 cm; lobed oblong or quadrangular, oblique, dentate at apex, usually 5-7 mm wide; texture solftly chartaceous to chartaceous, their edges often inrolled when dry; veins visible, the midrib grooved above with raised sides, the other veins distinct below, usually once or twice forked. **Sori** long almost parallel to the midrib, crescent-shaped, 1-4 for each lobe; indusia herbaceous, pale. **Fig. 6.67**

Thailand.- PENINSULAR: Nakhon Si Thammarat (Khao Luang).

Distribution.- Malaysia (type).

Ecology.- On mossy tree-trunks or on mossy rocks in Hill evergreen forest at 1050 m altitudes.

Specimens examined.- BCU: Y. Yuyen 189; P. Rachata 180; T. Boonkerd 39; BKF: E. Hennipman 3848; K. Iwatsuki et al 4785, T8396.

8. Asplenium scortechinii Bedd., J. Bot.: 322. 1887; Holttum, Rev. Fl. Malaya 2: 420. 1955; Tagawa & K. Iwats., Fl. Thailand 3(2): 271. 1985.- *Asplenium annaMémse* H. Christ, J. Bot. 21: 232, 246. 1908.

Rhizome short, suberect, bearing several fronds in a tuft, scaly near apex; scales oblong-lanceolate, gradually narrowing towards acute apex, about 3 by 1 mm, dark brown centrally, paler at adges, bearing irregular projections at margin, clatharte. **Stipes** in a close group, not distinct from lamina, winged, stramineous. **Lamina** simple, linear, up to 20-41 by 1.5-2 cm, broadest at middle, narrowing towards caudately long acuminate apex, attenuate towards base, with shallow serration at margin in upper part; texture chartaceous, minutely scaly on midrib below; ovate-acute, about 1 by 0.5 mm, dark brown; midrib raised below, flat above, rather thick; lateral veined forming angles of 70-80° to midrib, simple or forked, a minute notch in the margin just above each vein-ending. **Sori** elongate along simple veins or acroscopic branches of veins, from near midrib to about 2/3 way towards edge of frond; indusia pale, up to 8 by 1 mm, firm. **Fig. 6.71**

Thailand.- NORTH-EASTERN: Loei (Phu Luang, Phu Kradueng); SOUTH-EASTERN: Chanthaburi (Khao Soi Dao); PENINSULAR: Nakhon Si Thammarat (Khao Luang), Trang (Khao Chong, Khao Sung).

Distribution.- Indochina and Malaysia (type).

Ecology.- On mossy tree-trunks or on mossy rocks, usualy in Tropical evergreen forest and in Hill evergreen forest at 800-1050 m altitudes.

Specimens examined.- BCU: Y. Yuyen 39; BKF: E. Hennipman 3690, M. Tagawa et al 1826, Smitinand 5883.

9. Asplenium simonsianum Hook., Ic. Pl. 10: t. 925. 1854; Tagawa & K. Iwats., Fl. Thailand 3(2): 269. 1985.- *Thamnopteris simonsiana* (Hook.) T. Moore, Ind. Fil.: L. 1857; Bedd., Handb.: 141. 1969.

Rhizome short, erect or ascending, stout, bearing a rossett of fronds, usually with a mass of root, scaly at apex; scales brown, up to 2 cm long, 3 mm broad, clathrate. **Stipes** short, indistinct, about 4 cm long, glabrous. **Lamina** simple, linear, up to 70 cm long, 10 cm broad, broadest at middle portion, gradually narrowing toward both apex and base, acuminate apex, long attenuate at base; texture coriaceous, grass-green when living, paler below; midrib raised below, vein once or rarely twice forked, the first fork near midrib and then running parallel, uniting at apex to form submarginal veins about 1 mm inside leaf margin. **Sori** elongate along veins, extending from near midrib more than half-way to margin, often occupy 3/4 of the length of veins, usually on every vein; indusia about 1 mm broad, with a space of 1.5 mm or wider.**Fig. 6.73, 6.74**

Thailand.- NORTHERN: Tak (Huai Krasa, Doi Musoe).

Distribution.- Assam (type).

Ecology.- Epiphyte in Dry evergreen forest by stream or in Tropical evergreen forest at 320-800 m altitudes.

Specimens examined.- BCU: Y. Yuyen 2.

10. Asplenium unilaterale Lam., Enc. 3: 305. 1786; Holttum., Rev. Fl. Malaya 2: 438. 1955; Bedd., Handb.: 152. 1969; Tagawa & K. Iwats., Fl. Thailand 3(2): 277. 1985.

Rhizome slender, long-creeping, 3-4 mm diam., bearing many roots on ventral and two rows of fronds on dorsal surface, sparsely covered with darked brown scales and densely gloden hairy at apex; scales gradually narrowing from the base towards, up to 2 mm long, clathrate, entire. **Stipes** close or up to 1 cm apart, castaneous to purplish, polished, up to 10-20 cm long; rachis of the same colour, deeply grooved above with narrow wing on each side of the groove. **Lamina** pinnate, oblong-lanceolate, broadest at basal to middle portion, almost parallel or slightly narrowing upwards and then rather suddenly narrowing to caudate apex, about 20 by 4-5 cm; pinnae usually 23-25 pairs, about 2 by 0.7 cm, very shortly stalked, spreading, close but not imbricating, quadrangular, posterior half of lower portion dimidiate, truncate and slightly auricled at acroscopic base, rounded at apex, lobed to 1/5 way at upper and anterior half of lower margin, lobes rounded to acute at apex, oblique; texture thin,

herbaceous, deep green; veins distinct raised on both surface. **Sori** 3-4 mm long; indusia herbaceous, pale. **Fig. 6.72**

Thailand.- NORTHERN: Chiang Rai (Doi Phacho), Chiang Mai (Doi Phahom Pok, Doi Chiang Dao, Doi Suthep, Doi Inthanon), Lampang, Tak (Doi Musoe); CENTRAL: Nakhon Nayok (Khao Yai); SOUTH-EASTERN: Chanthaburi (Pong Nam Ron, Khao Soi Dao); SOUTH-WESTERN: Kanchanaburi (Wangka); PENINSULAR: Chumphon (Tha San), Ranong (Khao Phota Luang Kaeo, Tha Um), Trang (Khao Chong), Pattani (Bacho), Yala (Bannang Sata).

Distribution.- Widely distribution throughout the Old World tropics (type from Comoros), north to central Japan.

Ecology.- Terrestrial fern on wet sands or moist muddy rocks along stream in Hill evergreen forest at 1050 m altitudes.

Specimens examined.- BCU: Y. Yuyen 199; P. Rachata 58, T. Boonkerd 1488.

11. Asplenium yoshinagae Makino, Phan. Pterid.Jap. Ic. 111. 1: pl. 64. 1900; Tagawa & K. Iwats., Fl. Thailand 3(2): 285. f. 23. 1. 1985.- *Aspenium planicuale* Wall. ex Mett., Abhandl. Senckenb. Naturf. Ges. 3: 201; Devol and Kuo, Fl. Taiwan vol. 1. 2 nd ed.: 487. 1980.- *Asplenium indicum* Sledge, Bull. Brit. Mus (Nat. Hist.) Bot; 3: 264. 1965.

Rhizome short, erect, densely scaly at apex, bearing a tulf of fronds; scales dark brown to nearly black, narrow, subulate, entire, up to 6 by 0.5 mm. **Stipes** up to 12 cm long, dark green to brownish, not polished, sparsely scaly or some time scaly throughout, groved above. **Lamina** pinnate, narrowly lanceolate, commonly about 15-23 by 5-8 cm, acute to acuminate at apex; rachis like the upper part of stipe; pinnae 12 pairs, shortly stalked, dimidiate, rhomboid, acute at apex, broadly cuneate and auricled at acroscopic base, narrowly cuneate and entire at basiscopic base, margin irregularly lobed with dentate margin, oblique, 3.5-4.5 by 1-1.5 cm; texture chartaceous, deep green, brownish in dry specimens; sparsely scaly on underserface; veins dichotomously forked. **Sori** elongate along veins, up to 0.7-1 cm long; indusia thin. **Fig. 6.69**

Thailand.- NORTERN: Chiang Rai (Doi Phacho), Chiang Mai (Doi Phahom Pok, Doi Chiang Dao, Doi Suthep, Doi Inthanon), Lamphun (Doi Khun Tan), Tak

(Ban Musoe); NORTH-EASTERN: Phetchabun (Phu Maing), Loei (Phu Luang, Wang Saphung), Khon Kaen (Phu Wiang); CENTRAL: Saraburi (Hin Lap); PENINSULAR: Surat Thani (Ban Don).

Distribution.- Ceylon, N. & S. India, Myanmar, S. China, Indochina, Taiwan, Philippines, north to Japan (type).

Ecology.- Epiphytes on mossy tree-trunks or on mossy rocks in Hill evergreen forest at 1050 m altitudes.

Specimens examined.- BCU: Y. Yuyen 38; P. Rachata 103, 175; T. Boonkerd 1063; BKF: C. Phengklai et al 7372; J. F. Maxwell 96-1143, 96-1151.

BLECHNACEAE

Devol, Fl. Taiwan vol. 1. 2 nd ed.: 149. 1980.

Stock erect, rather stout; base of stipes covered with scales. **Lamina** pinnate; fertile fronds of the same shape as sterile or much narrower. **Sori** elongate, near the costa of pinna or the costules of it lobes, with indusium attached on the side of the sorus.

BLECHNUM

L., Sp. Pl.: 1077. 1753.

Rhizome stout, erect, scaly; scales narrow entire, margin with pale cartilaginous edges. **Lamina** imparipinnate; veins free, usually once or a few times forked. **Sori** linear, parallel and close to costa; indusia attached on the side away from costa and opening inwards.

Blechnum orientale L., Sp. Pl.: 1077. 1753; Holttum, Rev. Fl. Malaya 2: 446. f. 262. 1955; Bedd., Handb.: 132. f. 66. 1969; Devol, Fl. Taiwan vol. 1. 2 nd ed.: 149. 1980; Tagawa & K. Iwats., Fl. Thailand 3(3): 298. 1988.

Rhizome thick, ascending or suberect, densely covered with scales, scales linear gradually narrowing towards apex, about 1 cm or more long, up to 1 mm broad, tailed at apex brown, toothed at margin. **Stipes** stout, stramineous, purplish at base, up to 60 cm long, densely scaled at base, bearing small auricles (reduced pinnae) throughout. **Lamina** pinnate, up to 85 by 34 cm oblong, acuminate at apex, lateral

pinnae many in number, close, 2-3 cm apart from each other, ascending, linear, gradually narrowing toward long-tailed apex, round or subtruncate at sessile base, or deccurent at posterior base and adnate in the upper ones, entire, up to 20 by 1.5 cm; vein simple or forked usually near costa, distinct on both surfaces, very closed, up to 0.5 mm apart; texture coriaceous, green, glabrous throughout. **Sori** narrow, long continuous along costa; indusia narrow, brown, usually broken before maturity. **Fig. 6.75**

Thailand.- NORTHERN: Chiang Rai (Doi Tung), Chiang Mai (Kong Kat, Doi Suthep, Mae Rim), Tak (Ban Musoe, Raheng); NORTH-EASTERN: Loei (Phu Ruea, Phu Luang, Phu Kradueng), Nong Khai (Phon Phisai), Udon Thani; EASTERN: Chaiyaphum (Khao Kong); CENTRAL: Nakhon Nayok (Khao Yai); SOUTH-EASTERN: Chanthaburi (Laem Sing, Phriu Waterfall, Makham, Khao Sabap), Trat (Ko Kut, Ko Chang); PENINSULAR: Chumpon (Lang Suan, Ban Pak Chan), Ranong (Nok Nang), Surat Thani (Ban Don), Nakhon Si Thammarat (Khao Luang, Thap Chang), Phangnga (between Thanun and Phangnga), Trang (Khao Chang), Satun, Narathiwat (Waeng, Sungai Padi), Yala (Betong, Bannang Sata).

Distribution.- Tropics of Asia, Australia and the Pacific, India to Polynesia, north to Southern edge of Japan (Yakushima).

Ecology.- On rather dry open slopes in light shade in Mixed deciduous forest, or on moist slopes in Hill evergreen forest at 300-1050 m altitudes.

Vernacular.- Kut khang fan (กูดข้างฝาน) (Northern); kut doi (กูดดอย); mahasadam (มหาสดำ) (South-Eastern).

Specimens examined.- BCU: Y. Yuyen 22; T. Boonkerd 1031, 1114.

LOMARIOPSIDACEAE

Devol and Kuo, Fl. Taiwan vol. 1. 2 nd ed.: 347. 1980.

Rhizome creeping or high-climbing. **Lamina** simple or simply pinnate; veins free or anastomosing; fertile fronds acrostochoid, the pinnae usually very narrow.

Key to key genera

1. Frond simple, epiphytic or on cliffs; stipes usually jointed to rhizome **2. Elaphoglossum**
1. Frond pinnate, terrestrial ferns; stipes usually not jointed to rhizome **1. Bolbitis**

1. BOLBITIS

Schott, Gen. Fil.: ad. t. 14. 1834.- *Egenolfia* Schott, Gen. Fil.: ad. t. 16. 1834.- *Campium* C. Presl, Tent. Pterid.: 238. Pl. X. 22-23. 1836.

Rhizome creeping. **Lamina** dimorphic, not jointed to rhizome, simple to bipinnatifid, often viviparous near apex. Sporangia dispersed on the whole undersurface of fertile pinna or fronds.

Key to the species

1. Veins anastomosing; lateral pinnae up to 4-5 cm wide
   2. No included free veinlets in areoles; lateral pinnae entire; terminal pinna very long tailed **2. B. heteroclita**
   2. Many included and excurrent free veinlets in areoles; lateral pinnae toothed at margin; terminal pinna like lateral ones or slightly larger **4. B. virens var. compacta**
1. Veins all free, lateral pinnae about 3.5 cm wide or less
   3. Base of lateral pinnae unequal, with auricle at aterior base; pinnae up to 12-22 pairs, serrate at margin. **1. B. appendiculata subsp. appendiculata**
   3.Base of lateral pinnae nearly equal; pinnae about 8 pairs, lobed halfway to costa. **3. B. sinensis var. sinensis**

1. Bolbitis appendiculata (Willd) K. Iwats. subsp. **appendiculata**, Acta Phytotax. Geobot. 18:48. 1959; Hennipm., Fl. Mal. II. 1: 322. f. 26b, 27d-f. 1978; Tagawa & K. Iwats., Fl. Thailand 3(3): 316. 1988.- *Acrostichum appendiculatum* Willd., Sp. Pl. 5: 114. 1810.- *Polybotrya appendiculata* (Willd.) J. Smith, J. Bot. 4: 150. 1841; Bedd., Handb.: 434. f. 255. 1969.- *Egenofia appendiculata* (Willd.) J. Smith., Ferns Br. For.: 111. 1866; Holttum, Rev. Fl. Malaya 2: 459. f.270. 1955; Devol and Kuo, Fl. Taiwan vol. 1. 2 nd ed.: 350. 1980.- *Polybotrya helferiana* Kunze, Farnkr. 2: 35. 1849.- *Polytrya appendiculata* var. *helferiana* (Kunze) H. Christ, Bot. Tidsskr. 24: 109. 1901.- *Egenoifia helferiana* (Kunze) C. Chr., Contr. U. S. Nat. Herb. 26: 292. 1931.- *Polybotrya appendiculata* var. *marginata* (Bl.) C. Chr., Bot. Tidsskr. 32. 343. 1916.- *Polybotrya marginata* En. Pl. Jav.: 100. 1828.- *Egenolfia appendiculata* var. *moniliformis* Tardieu & C. Chr. in Fl. Gen. I.-C. 7(2): 427. 1941.- *Acrostichum* sp. Hosseus, Beih. Bot. Centr. 28(2): 363. 1911.

Rhizome creeping, the apex covered with scales; scales light brown or greyish, linear, up to 4 mm long, 1 mm broad, **Sterile fronds:** stipes closed together, slender, stramineous, sparsely scaly similar to those on rhizome, 5-15 cm long; lamina

lanceolate, acuminate at apex, up to 15-27 by 5-9 cm; rachis scaly beneath, winged at least on upper part, sometime viviparous near apex; pinnae 12-22 pairs, basal ones slightly shorter than the next above, middle ones the largest, patent or ascending, subsessile, oblong or gradually narrowing from base to apex, round to acute at apex, more auricled at acroscopic and dimidiate at basiscopic bases, margin shallowly lobed, 3-5 by 1-1.5 cm, the apical pinna variable in shape and size, usually narrowly subtriangular; vein pinnate, all free; lobed shallow, round, whit a distinct tooth at each sinus; texture papyraceous, deep green. **Fertile fronds:** taller; stipes up to 15 cm long; lamina linear-lanceolate, 12-19 by 1-1.5 cm; rachis wingless; pinnae subbsessile, oblong with round apex, base shape as in sterile pinnae but not auricle, edged slightly crenate, with very short sinus, 7-10 by 3 mm; veins hardly visible; sporangia dispered on lower surface of pinna or lobes. **Fig. 6.78**

Thailand.- NORTHERN: Chiang Mai (Doi Suthep, Doi Inthanon), Lampang; NORTH-EASTERN: Phetchabun (Phu Miang), Loei (Phu Luang), Sakon Nakhon (Pha Kham Hom); EASTERN: Nakhon Ratchasima (Pak Thong Chai), Chaiyaphum; SOUTH-EASTERN: Chanthaburi (Khao Sabap), Trat (Ko chang); SOUTH-WESTERN: Kanchanaburi (Sai Yok, Mae Nam Noi); PENINSULAR: Chumpon (Khao Nam Sao, Ban Krayae), Phangnga (Ta Kau Pa, Ko Tililong, Khao Phra Mi), Phuket (Thalung), Nakhon Si Thammarat (Khao Luang, Khao Khi No, Khiriwong, Chawang), Trang (Khao Chong), Song Khla, Satun.

Distribution.- S. China, India to SE. Asia generally, throughout Malesia, northwards to Taiwan and Ryukyus (Type from India Or.).

Ecology.- On muddy rocks in Tropical evergreen forest or Hill evergreen forest at 940-1050 m altitudes.

Specimens examined.- BCU: Y. Yuyen 53, 149; T. Boonkerd 1273, 1360, 1465.

2. <u>Bolbitis</u> <u>heteroclita</u> (C. Presl) Ching, Ind. Fil. Suppl. III.: 48. 1934; Holttum, Rev. Fl. Malaya 2:462. f. 271. 1954; Hennipman in Fl. Mal. II. 1: 325. f. 25d, 31a-g. 1978; Devol and Kuo, Fl. Taiwan vol. 1. 2 nd ed.: 348. pl. 122. 1980; Tagawa & K. Iwats., Fl. Thailand 3(3): 320. 1988.- *Acrostichum heteroclitum* C. Presl, Rel. Haenk. I.: 15. pl. 2. f. 2. 1825.- *Leptochilus heteroclitus* (C. Presl) C. Chr., Ind. Fil.: 385. 1906.

Rhizome slender, long-creeping, with stipes usually in two ranks or more closely placed in several ranks, when climbing on rock or trees, scaly; scales nearly black with narrow brown ferrugineous margin, lanceolate, up to 3 mm long, 0.5 mm broad. **Sterile fronds:** stipes 15-20 cm long, stramineous; bearing sparsely small scales throughout; lamina imparipinnate with two pairs of lateral pinnae; lateral pinnae oblong, cuneate and shortly stalked at base, cuadate at apex, up to 4-5 cm apart, 10-20 by 3-5 cm; almost entire or irregularly shallowly waved, terminal pinna oblong, or often very long tailed with narrow linear tails up to 53 cm long, 5-6 cm broad; rachis narrowly winged, grooved above; glabrescent; costa naked, sometime viviparous; veins distinct on both surface finely reticulated, with out included free veinlets; texture herbaceous or softly papyraceous, glabrous, deep green or bright green. **Fertile fronds:** stipes nearly the same as or longer than sterile ones, up to 10-27 cm long; lamina imparipinnate, lateral pinnae 4 pairs, oblong, cuadately at apex, about 5-13 by 1-3.5 cm; apical pinna a little larger than lateral ones, veins reticulate; sporangia spread over the whole undersurface of pinnae. **Fig. 6.77**

Thailand.- NORTHERN: Chiang Rai (Mae Kok), Chiang Mai (Doi Chiang Dao), Lampang, Phitsanulok (Nakhon Thai, Thung Salaeng Luang); CENTRAL: Nakhon Nayok (Khao Yai); SOUTH-EASTERN: Chonburi (Si Racha), Chanthaburi (Nam Tok Takhamao, Long Nam Ron), Trat (Phriu Waterfall, Huai Raeng); SOUTH-WESTERN: Kanchanaburi (Khao Yai), Prachuap Khiri Khan (Khao Luang); PENINSULAR: Nakhon Si Thammarat (Khao Luang), Trang (Khao Chong).

Distribution.- N. India, upper Myanmar, S. and SW. China, Taiwan, Ryukyu, Indochina, Throughout Malesia (Type from Luzon) to New Guinea.

Ecology.- Epiphytics fern on base of tree-trunks in Tropical evergreen forest at 800 m altitudes.

Vernacular.- Kut pao (กูดเป๋า), Kut hang nok kaling (กูดหางนกกะลิง) (Northern).

Specimens examined.- BCU: Y. Yuyen 69 ; P. Rachata 144, 219; T. Boonkerd & R. Polwatn 64.

3. Bolbitis sinensis (Baker) K. Iwats var. **sinensis**, Acta Phytotax. Geobot. 18: 49. 1959; Hennipman, Fl. Mal. II. 1: 325. f. 27h. 1978; Tagawa & K. Iwats., Fl. Thailand 3 (3): 318. f. 26. 1-4. 1988.- *Acrostichum sinense* Bak., Kew Bull. 1906.- *Egenolfia sinensis* (Bak.) Maxon, Proc. Biol. Soc. Wash. 36: 173. 1923.

Rhizome creeping, up to 5 mm diam, scaly; scales light greyish-brown, narrowly subtriangular with long acuminate apex, entire, Mémbranous, up to 3 mm long, 1 mm broad, **Sterile fronds:** pinnatifid; stipes up to 8-24 cm long, stramineous, scaly at base with light-greyish brown liked rhizome, appressed, Mémbraneous, small, broadly ovate-oblong scales; lamina up to 30 by 20 cm; narrowly subtriangular, the apex attenuate long-tailed, often viviparous at apex; rachis and costa sparsely scaly, winged in upper part; lateral pinnae up to 8 pairs, basal pinnae the longest, asymetrically oblong-lanceolate, caudately acuminate at apex, lobed to 4/5 way towards costa, up to 11 by 3.5 cm, stalked, middle pinnae patent, oblong-lanceolate, shortly stalked, upper ones ascending, oblong, moderately acute to round at apex, margin entire, adnate at base to form indistinct apical pinna; lobes oblique, round at apex, up to 7 mm broad, close to other, main vein raised beneath, sparsely minutely scaly, veinlet forked, all free; texture herbaceous to subpapyraceous, deep green. **Fertile fronds:** about the same height as or lower than the sterile one; stipes 20-27 cm long; laminar narrower, 18 by 8 cm; lower lateral pinnae oblong, gradually narrowing from base to apex, rounded at distinctly stalked base, round to moderate acute at apex, subentire or very slightly waved at margin, terminal pinna subtriangular with lobed base, about 6 cm long; veins pinnate, veinlets simple or forked, all free, the apex ending inside the distinct cartilaginous margin; sporangia dispered on the undersurface, naked. **Fig. 6.79**

Thailand.- NORTHERN: Chiang Rai (Doi Tung, Doi Pacho), Chiang Mai (Doi Chiang Dao, Doi Suthep, Doi Chang, Pang Bo, Doi Inthanon), Lampang, Lamphun (Doi Khun Tan); NORTH-EASTERN: Phetchabun (Phu Miang), Loei (Phu Luang); SOUTH-EASTERN: Chanthaburi (Khao Soi Dao).

Distribution.- N. India, Myanmar, SW. China (Type) and Tonkin.

Ecology.- Terrestrial fern on humus rich slopes or on muddy rocks or on base of tree-trunks in Hill evergreen forest at 1050 m altitudes.

Vernacular.- Kut bong (กูดบ้ง) (Northern).

Specimens examined.- BCU: Y. Yuyen 91, 150; P. Rachata 35, 350; T. Boonkerd 82, 1351.

4. Bolbitis virens (Wall. ex Hook. & Grev.) Schott var. **compacta** Hennipman, Blumea 18: 149. 1970; Leid. in Fl. Mal. II. 1: 321. f. 25 a-c. 1978; Tagawa & K. Iwats., Fl. Thailand 3(3): 316. 1988.

Rhizome rather stout, creeping, the apex clothed with densely scales; scales thin but firm, dark brown, up to 1-1.5 mm long, 5 mm broad, entire. **Sterile fronds:** stipes 30-35 cm long, densely scaly throughout, scales on upper portion light brown, ferrugeneous, appressed, irregular in shape; lamina imparipinnate, oblong-ovate to oblong, acuminate at apex, 30-40 by 25-35 cm; lateral pinnae 2-4 pairs, stalked, about 5-8 mm long, upper portion subsessile, straight, ascending or patent in lower ones, oblong to oblong-lanceolate, cuadate at apex, narrowly cuneate or unequally rounded at base, up to 15-25 by 4-5 cm, toothed at margin, more or less waved; costa minutely scaly beneath, veins slightly raised on undersurface, reticulate with a few veinlets in each areole; texture subcoriaceous, glabrous, green both in living and dried condition, terminal pinna like lateral ones or slightly larger, viviparous near apex. **Fertile fronds:** as long as sterile ones; stipes up to 40-55 cm long; lamina up to 22-30 by 13-15 cm; pinnae 4-5 pairs, linear, acuminate at apex, stalked, up to 5-8 by 0.8-1 cm, about 3-7 times as long as wide; sporangia dispered on the whole undersurface of pinnae. **Fig. 6.80**

Thailand.- PENINSULAR: Phangnga (Khao Phra Mi), Trang (Khao Chong, type).

Distribution.- Malaysia, also Cochinchina.

Ecology.- Terrestrial or on moist rocks in Tropical evergeen forest at 840 m altitudes.

Specimens examined.- BCU: Y. Yuyen 32; P. Rachata 14; T. Boonkerd 1537, 1567.

2. ELAPHOGLOSSUM

Schott. ex J. E. Smith, Gen. Fil.: ad t. 14. 1843.

Rhizome creeping. **Stipes** swollen at base, jointed to rhizome. **Lamina** simple, entire, dimorphic; veins simple or forked, parallel or anastomosing. **Sporangia** dispersed on the whole undersurface, of fertile fronds.

Elaphoglossum subellipticum Rosenst., Hedwigia. 56: 348. 1915; Tagawa & K. Iwats., Fl. Thailand 3(3): 306. f. 25. 4-6. 1988.

Rhizome short, bearing close fronds, densely scaly throughout; scales brown or light brown, shining, linear, gradually narrowing to apex, up to 10 by 1 mm, with projection at margin. **Sterile fronds:** stipes about 3-5 cm long, stramineous, winged on upper part, scaly at base like those on rhizome; lamina simple, oblong, acute at apex, cuneate at base, about 8-17 by 1.5-2.5 cm; midrib distinctly raised on lower surface, veins hardly visible on both surface, cartilaginous membrane at margin narrow; texture coriaceous, green, very sparsely scaly on lower surface. **Fertile fronds:** stipes about 9-11 cm long, winged at upper most part; lamina broadest at middle, gradually narrowing towards both ends, up to 8-10 by 1 cm; sporangia spread over the whole undersurface of pinnae. **Fig. 6.76**

Thailand.- NORTH-EASTERN: Loei (Phuluang, Phukradung).

Distribution.- Taiwan (type) and Sumatra.

Ecology.- On mossy tree-trunks in Hill evergreen forest at 1050 m altitudes.

Vernacular. Kut pik kai dam (กูดปีกไก่ดำ) (Northern-eastern).

Specimens examined.- BCU: Y. Yuyen 78, 134.

DRYOPTERIDACEAE

Devol and Kuo, Fl. Taiwan vol. 1. 2 nd ed.: 359. 1980.

Stock short, more or less erect, usually densely scaly at apex; scales brown to neary black, hairy on the edges. **Stipes** often scaly. **Lamina** pinnate to bipinnate or more amply divided; leaflets oblique at base; vein free or anastomosing. **Sori** on the veins or at vein-tips; indusia kidney-shapes or peltate or in few species lacking.

Key to the genera

1. Veins all free; basal posterior vein of vein-group running from costule
   2. Ultimate lobes bearing distinct awn; no teeth in sinus between lobes
      3. Indusium round; veins bearing fibroid scales **3. Polystichum**
      3. Indusium reniform; veins glabrous **1. Dryopteris**
   2. Ultimate lobes entire; teeth in sinus between lobes present **4. Pteridrys**
1. Veins anastomosing or free with the basal posterior vein-group running directly from costa
   4. Basal pinna lobed with short basal posterior lobes or pinnules **2. Heterogonium**

4. Basal pinna unlobed, or when lobed the basal basiscopic lobes or pinnules longest **5. Tectaria**

1. DRYOPTERIS

Adans., Fam. Pl. 20, 551. 1763.

Rhizome short, ascending to erect, scaly. **Stipes** in a tuft at apex of rhizome. **Lamina** pinnate to decompound, basal anterior pinnules interior to basal posterior ones or catadromic in sequence of frond-architecture; texture papyraceous; veins all free. **Sori** dorsal on veinlets, round with punctate receptacle; indusia round-reniform, attached at the inner end of sinus, or rarely wanting.

Dryopteris sparsa (D. Don) Kuntze, Rev. Gen. Pl. 2: 813. 1891; Holttum, Rev. Fl. Malaya 2: 492. f. 292. 1955; Devol and Kuo, Fl. Taiwan vol. 1. 2 nd ed.: 380. 1980; Tagawa & K. Iwats., Fl. Thailand 3(3): 352. 1988.- *Nephrodium sparsum* D. Don, Prod. Fl. Nepal.: 6. 1825.- *Lastrea sparsa* (Don) T. Moore, Ind. Fil.: 87, 104. 1858; Bedd., Handb.: 252. 1969.

Rhizome short, erect, scales Mémbranous, light brown or the centre dark brown, oblong-ovate, about 9 by 4 mm. **Stipes** castaneous at least towards base, stramineous above, densely scaly at base, sparsely so above, up to 34 cm long. **Lamina** bipinnate to tripinnate at widest base, oblong-subdeltoid, acuminate at apex, up to 45 by 24 cm; basal pinnae the largest, asymmetrically subtriangular, acuminate at apex, up to 14 by 4 cm; middlle pinnae falcate, stalked, subtriangular-lanceolate; pinnae oblong, slightly falcate, rounded or moderately acute at apex, unequally cuneate at sessile base or deccurent at base in upper ones, up to 30 by 10 mm, lobed 1/3 way to midrib, bearing a distinct awn; basal basiscopic pinnule of lower pinnae large, about twice as large as the next one, pinnate; lobes oblong, oblique, rounded or moderately acute at apex, serrate at margin; texture papyraceous to chartaceous, deep green above, pale beneath; veins pinnate, veinlets simple, ending within margin of lobes. **Sori** costular or medial; indusia large, about 1 mm diam, glabrous. **Fig. 6.81**

Thailand.- NORTHERN: Chiang Rai (Mae Lap), Chiang Mai (Doi Chiang Dao, Doi Suthep); NORTH-EASTERN: Loei (Phu Luang, Phu Kradueng); SOUTH-EASTERN: Chanthaburi (Khao Soi Dao); PENINSULAR: Nakhon Si Thammarat (Khao Luang).

Distribution.- India (type), China, Indochina, throughout Malesia to Polynesia, Taiwan and north to S Japan.

Ecology.- On mountain slopes in Hill evergreen forests or in light shade at 1050 m altitudes.

Specimens examined.- BCU: Y. Yuyen 35; BKF: K. Iwatsuki & N. Fukuoka T7193; M. Tagawa et al. 1260; T. Smitinand 5913.

2. HETEROGONIUM

C. Presl, Epim.: 142. 1851.- *Ctenitopsis* Ching, Bull. Fan Mém. Inst. Biol. 8: 304. 1938.

Rhizome short, erect with dark castaneous scales. **Stipes** fuscous, hairy, with articulate hairs, scaly at base. **Lamina** catadomous in plan (the basal anterior pinnules interior to the basal posterior one), pinnate to bipinnatifid; texture herbaceous, hairy; veins free or anastomosing. **Sori** dorsal on veins round or elongate; indusia reniform or naked.

Heterogonium gurupahense (C. Chr.) Holttum, Reinwardtia 3: 272. 1955; Tagawa & K. Iwats., Fl. Thailand 3(3): 361. f. 33. 6-7. 1988.- *Dryopteris sagenioides* var. *gurupahense* C. Chr., Svensk Bot. Tidsskr. 16: 95. f. 2. 1922.- *Aspidium sagenioides* auct. auct. non Mett.: H. Christ, Bot. Tidsskr. 24: 108. 1901.- Dryopteris saginiodes non (Mett.) O. Ktze.: C. Chr., Bot. Tidsskr. 32: 342. 1916.- *Ctenitopsis sagenioides* (Mett.) Ching, Bull. Fan Mém. Inst. Biol. 8: 312. 1938.

Rhizome short, erect or ascending, bearing a tuft of fronds; scales subtriangular, gradually narrowing towards tailed apex, dark brown center, stiff, paler and somewhat furrugineous at margin, hairy, about 3 by 1 mm. **Stipes** deep purple, polished, up to 20 cm long, pubescent throughout. **Lamina** bipinnatifid, oblong-lanceolate, acuminate at apex, up to 30 by 15 cm; lateral pinnae about 10 pairs or more, sessile, oblong-lanceolate, cuadate at apex, truncate at base, deeply lobed 1/3 way towards costa, basal pinna distincly long basiscopic lobed, up to 7 by 4 cm; lobed oblong to oblong-subdeltoid, rounded to acute at apex, entire or crenulate in larger ones, falcate; texture herbaceous, greenish, hairy on both surfaces, costules and veins hairy; veins forked; hairs on upper surface dense, of two kinds, the larger ones more or

less articulated, the shorter ones slender. **Sori** dorsal on veinlets, medial, round; indusia small, fagacious, densely hairy. **Fig. 6.82**

Thailand.- NORTHERN: Chiang Rai, Chiang Mai (Ban Du), Phitsanulok (Thung Salaeng Luang); CENTRAL: Nakhon Nayok (Khao Yai); SOUTH-EASTERN: Rayong (Khao Chamao), Chanthaburi (Khao Soi Dao, Khao Sabap), Trat (Bo Rai, Ko Chang); PENINSULAR: Ranong (Ko Banghen), Surat Thani (Ban Don), Phangnga (Khao Katha Khwam, Khao Phra Mi), Phuket (Thalang), Nakhon Si Thammarat (Khao Luang), Trang (Khao Chong), Pattani (Yaring), Narathiwat (Waeng).

Distribution.- Myanmar (Mergui and Tenasserium), Vietnam, W Malesia and Celebes (type).

Ecology.- On mountain slopes in Tropical evergreen forests at 800 m altitudes.

Specimens examined.- BCU: Y. Yuyen 197; BKF: M. Tagawa T11787; M. Tagawa et al. T6808; Tatemi et al. T26442; T. Shimizu et al. 26967.

3. POLYSTICHUM

Roth, Arch. Bot. 2(1): 106. 1799.

Rhizome short, erect with rather broad scales, lacerate. **Stipes** densely scaly. **Lamina** pinnate to bipinnate; texture coriaceous, with mucronate apex of ultimate lobes; veins all free, usually bearing fibroid scales. **Sori** dorsal on veins, round; indusia round, peltate or rarely wanting.

Key to the species

1. Rachis gemmiferous; basal acroscopic pinnules larger; scales black at central portion and light brown margin, up to 10 by 5 mm **1. P. attenuatum**
1. Rachis not gemmiferous; basal basiscopic pinnules larger, 1-pinnate; scales dark brown, entire margin, up to 12 by 1 mm **2. P. biaristatum**

1. Polystichum attenuatum Tagawa & K. Iwats., Acta Phytotax. Geobot. 23: 113. f. 9. 1968; Tagawa & K. Iwats., Fl. Thailand 3(3): 335. f. 29. 3-5. 1988.- *Polystichum* sp.; Tagawa & K. Iwats., Southeast As. St. 5: 94. 1967.

Rhizome short, scaly at apex; scales oblong with acuminate apex, rounded at base, up to 10 by 5 mm, rigid, bicoloured with nearly black central portion and light brown margin, marginal portion caducous, often leaving concolorous black scale on

older portion of rhizome. **Stipes** up to 15-25 cm long, scaly at base. **Lamina** bipinnate, narrowly subtriangular, commonly widest at base, up to 25-40 by 10-18 cm; rachis scaly with brown linear scales less than 0.7 mm broad, gemmiferous on upper part; lateral pinnae up to 30 pairs or more, oblong or slightly narrowing from base to apex, falcate, auricle at acroscopic base, dimidiate at basiscopic base, upper ones pinnatifid, a few lowest pinnae very shortly stalked, patent, slightly falcate, up to 9 cm long, more than 2 cm wide; basal acroscopic pinnules about 1.5 time larger than the next one; pinna-rachis minutely linear scaly, narrowly winged; pinnules of lower pinnae oblong or more usually narrowing from base to acute apex, auricle at acroscopic and dimidiate at basicopic base, apex of lobes ending in awns; veins minutely scaly beneath, not raised on both surface; texture subcoriaceous, glabrous on laminar surface, green. **Sori** closed to midrib of pinnule; indusia small, glabrous, caducous. **Fig. 6.83**

Thailand.- NORTHERN: Chiang Mai (Doi Chiang Dao, Doi Suthep, Doi Inthanon); NORTH-EASTERN: Loei (Phu Luang, type, Phu Kradueng); SOUTH-EASTERN: Chanthaburi (Khao Soi Dao).

Distribution.- Endemic.

Ecology.- Terrestrial fern on humus-rich mountain slopes in Hill evergreen forests at 1040 m altitudes.

Specimens examined.- BCU: Y. Yuyen 84; BKF: M. Tagawa et al 1487; Smitinand 3028.

2. <u>Polystichum</u> <u>biaristatum</u> (Blume) T. Moore, Ind. Fil.: 86. 1858; Devol and Kuo, Fl. Taiwan vol. 1. 2 nd ed.: 388. 1980; Tagawa & K. Iwats., Fl. Thailand 3(3): 337. f. 29. 10-11. 1988.- *Aspidium biaristatum* Bl., En. Pl. Jav.: 164. 1828.- *Polystichum aculeatum* var. *biaristatum* (Bl.) Bedd., Handb.: 209. 1883.- *Aspidium aculeatum* auct. non (L.) Sw.: Hoss., Beih. Bot. Centr. 28(2): 363. 1911.- *Polystichum aculeatum* auct. non (L.) Schott: Holttum, Dansk Bot. Ark. 20: 30. 1961.

Rhizome short, suberect, scaly at apex; scales narrowly subtriangular, attenuate at apex, margin entire, dark brown, up to 12 by 1 mm. **Stipes** stramineous, up to 45 cm long, scaly at base; scales of two kids, one like those on rhizome, the other narrower, linear, up to 6 mm long, dark-brown, entire at margin, all axes grooved above. **Lamina** tripinnatifid to tripinnate at base, triangular in outline, about 40 by 40 cm; rachis scaly with linear black; lateral pinnae 15 pairs or more, gradually reducing in size to apex, lower first to third pinnae bipinnate with stalked, upper pinnae 1-pinnate to simple

with short stalked to sessile; lowest pinnae about 20 by 12 cm; first basicopic pinnule larger, 1-pinnate; pinnules rather close, slightly reducing to apex, oblong, falcate, pinnate to shallowly lobed, with sharp awns at apex of lobes, sessile; veinlets raised on lower surface, minutely scaly; texture subcoriaceous, green. **Sori** arranged in one row at submarginal or medial part of pinnules; indusia pale brown, about 1 mm diam. **Fig. 6.84**

Thailand.- NORTHERN: Chiang Rai (Mae Talop, Doi Phacho), Chiang Mai (Doi Suthep, Doi Inthanon), Tak (Khun Kong San); NORTH-EASTERN: Loei (Phu Paek); SOUTH-EASTERN: Prachin Buri (Khao Yai), Chanthaburi (Khao Soi Dao).

Distribution.- Sri Lanka, N India, S China, Taiwan and Indonesia (type).

Ecology.- Terrestrial on humus-rich mountain slopes in Tropical evergreen forests at 800 m altitudes.

Specimens examined.- BCU: Y. Yuyen 204; BKF: T. Smitinand & E. C. Abbe 6229.

4. PTERIDRYS

(C. Chr.) C. Chr. & Ching, Bull. Fan Mém. Inst. Biol. 5: 125. 1935.

Rhizome short, erect, scaly. **Stipes** scaly or glabrescent. **Lamina** pinnatifid with distinct, pinnatisect apical pinnae; texture chartaceous; basiscopic branch of anterior basal vein meeting at sinus with that of posterior basal vein of next segment but never actually uniting, basal veins sometimes springing directly from costa; a prominent deltoid tooth at each sinus between adjacent pinnules. **Sori** dorsal or terminal on short acroscopic branch of veins, round, one row at each side of costule; indusia round-reniform.

Pteridrys syrmatica (Willd.) C. Chr. & Ching, Bull. Fan Mém. Inst. Biol. 5: 131. pl. 11, 17. 1934; Holttum, Rev. Fl. Malaya 2: 530. f. 311, 312. 1955; Tagawa & K. Iwats., Fl. Thailand 3(3): 388. 1988.- *Aspidium syrmatica* Willd., Sp. Pl. 5: 237. 1810.- *Lastrea syrmatica* (Willd.) T. Moore, Ind. Fil.: 105. 1858; Bedd., Handb.: 243. f. 124. 1969.

Rhizome short, creeping or assending, bearing a tuft of stipes; scales lanceolate, round or cordate at base, tailed at apex, up to 7 by 1 mm, dark brown. **Stipes** up to 30 cm long, stramineous to pale castaneous, scaly at base, glabrescent

above. **Lamina** pinnate with deeply lobed pinnae, oblong to oblong-lanceolate, 30-40 by 15 cm, rachis glabrescent, pale stramineous to deep brown, lateral pinnae 6-9 pairs, ascending, petiole of basal pinnae 1 cm long, lanceolate, subtruncate to broadly cuneate at base, up to 13 by 3 cm, deeply lobed to 4/5 way towards costule; lobes oblong, oblique, round at apex, serrate at margin, up to 16 by 6 mm; texture papyraceous, deep green, glabrous; costules pale, glabrous, raised on both surfaces; veins pinnate, the basale basiscopic veinlets springing directly from costa, veinlets forked, acroscopic branches stopped at midway, basiscopic branches running into the projection at margin, and a branch into sinus-teeth. **Sori** apical or subapical at acroscopic branches of veinlets, thus medial; indusia reniform, glabrous. **Fig. 6.85**

Thailand.- NORTHERN: Chiang Mai (Tin Tok); SOUTH-WESTERN: Prachuap Khiri Khan (Khao Luang, Bang Saphan); PENINSULAR: Surat Thani (Ko Samui, Ko Hua Khwai, Ban kop kaep, ko Tao), Phangnga, Nakhon Si Thammarat (Khao Luang), Trang (Khao Chong), Satun (Ko Chong Lat, Ko Lan Ta Yai), Yala (Ban Wiang, Ban Chana).

Distribution.- Sri Lanka, Cochinchina and Malesia, east to Celebes and Philippines.

Ecology.- On humus rich ground in Dry evergreen forest at 400 m altitudes.

Vernacular.- Kut kham (กูดคำ), Di ngu wa (ดีงูหว้า) (Northern); Neraphusi thet (เนระพูสีเทศ) (Central).

Specimens examined.- BCU: Y. Yuyen 11, 27; BKF: Bertel Hansen & Tem Smitinand 12259; Ch. Charoenphol et al. 1404; J. F. Maxwell 84-483; K. Iwatsuki 8490.

5. TECTARIA

Cav., Ann. Hist. Nat. 1: 115. 1799.- *Ctenitopsis* Ching, Bull. Fan Mém. Inst. Biol. 8: 304. 1938.

Rhizome thick, short, erect to short-creeping, scaly at apex. **Stipes** stramineous. **Lamina** simple to amply divided; all axes hairy with articulated multicellular hairs; veins free to various anastomosing with or without included veinlets. **Sori** terminal on included free veins, dorsal on veins or compital on

connected veins, round, indusiate or exindusiate, or some elongate; indusia if present round-reniform.

Key to the species

1. Sori usually terminal on included free veinlets, often two rows between main veins
   2. Stipe not densely scaly except for the base; lamina up to 25 by 20 cm, fertile frond usually much contracted **3. T. impressa**
   2. Stipe hairy as well as scaly throughout; lamina up to 70 by 50 cm, fertile frond not or slightly contracted **1. T. griffithii**
1. Sori on anastomosing veins; frond pinnate, pinnae about 20 by 6 cm; apical pinnae similar to next above, cuneate to round at base **2. T. polymorpha**

1. Tectaria griffithii *(Baker) C. Chr., Ind. Fil. Suppl. 3: 180. 1934;* Tagawa & K. Iwats., Fl. Thailand 3(3): 370. 1988.- *Nephrodium griffithii* Bak., in Hook. & Bak., Syn. Fil.: 300. 1867.- *Nephrodium multicaudatum* Clarke, Trans. L. Soc. II. 1: 540. t. 77. 1880.- *Tectaria multicaudata* (Clarke) Ching, Sinensia 2: 20. 1931; Holttum, Rev. Fl. Malaya 2: 507. f. 299. 1955.- *Aspidium multicaudatum* (Clarke) Bedd., Handb.: 222. 1883.

Rhizome short, erect, scaly, scales linear-subtriangular, up to 15 by 1 mm, entire, dark brown. **Stipes** stout, dark brown to castaneous, up to 80 cm long, scaly throughout but scale gradually sparsely upwards, hairy at least on adaxial surface. **Lamina** oblong-subdeltoid or pentagonal, up to 70 by 50 cm; lateral pinnae 4-5 pairs, basal pinna the largest, with long stalk, asymmetrically subdeltoid, acute at apex, up to 31 by 15 cm, 1 or 2 basal basiscopic pinnules much longer, free with short stalks, oblong-lanceolate, cuadately-acuminate, deeply lobed, up to 10 by 3 cm, 1 or 2 basal acroscopic pinnules free; middle pinnae smaller, with 1 or 2 free pinnules; apical pinna oblong-subdeltoid, acute at apex, broadly cuneate and alittle decurrent at base, deeply lobed to pinnatifid; texture herbaceous, dark green, glabrous on both surfaces; rachis costae and costules densely short hairy above, sparsely scaly beneath; vein anastomosing to form copious areoles. **Sori** round, terminal on short free included veinlets, indusiate in a single row at each side of midrib, medial or a little costular, more or less immersed and raised on upper surface; indusia large, round-reniform, up to 2 mm diam., persistent, glabrous. **Fig. 6.86**

Thailand.- NORTHERN: Lampang; NORTH-EASTERN: Loei (Tha Li); SOUTH-EASTERN: Chanthaburi (Khao Sabap), Trat (Huai Raeng); SOUTH-

WESTERN: Kanchanaburi (Wangka, Khao Ngi Yai, Song Tho); PENINSULAR: Phangnga (Tha Kau Pa, Khao Nang Hong), Krabi (Khao Ao khuan), Nakhon Si Thammarat (Khao Luang), Yala (Bannang Sata Waterfall).

Distribution.- N. India, Myanmar (type), SW. China, Indochina, W. Malesia to Philippines.

Ecology.- On humus-rich slopes usually along stream in Hill evergreen forests at 1050 m altitudes.

Vernacular.- Kachot raet (กะฉอดแรด) (South-easthern).

Specimens examined.- BCU: Y. Yuyen 44; T. Boonkerd 1164, 1186.

2. Tectaria impressa (Fée) Holttum., Kew Bull. 43: 483. 1988.- *Phlebigonium impressum* Fée, Gen. Fil.: 314. 1852.- *Tectaria variolosa* (Wall. ex Hook.) C. Chr., Contr. U. S. Nat. Herb. 26: 289. 1931; Tagawa & K. Iwats., Fl. Thailand 3(3): 368. 1988.

Rhizome short, creeping or suberect, 3-5 mm in diam., the apex and base of stipes covered with rather thin shining brown scales; scale linear, hairy at margin, rather stiff, bicoloured, black central portion with brown ferrugineous edges or concolorous brown, up to 7 by 0.6 mm. **Stipes** pale brown to castaneous, up to 15-35 cm in sterile and up to 40-60 cm long in fertile fronds, densely pubescent on adaxial surface, glabrous beneath. **Lamina** tripinnatifid at base, ovate-subdeltoid or pentagonal, up to 25 by 20 cm; lateral pinnae 2-4 pairs, basal pinna largest, stalked, asymmetrically subtriangular, acute at apex, with one or two basal basiscopic pinnules; upper pinnae shortly stalked, deeply lobed or with a free sessile basal basiscopic pinnule; apical pinna subdeltoid, cuneat and a little deccurent at base, deeply lobed to pinnatifid; texture herbaceous, green, glabrous on lamina surface; rachis and pinna-rachis with dense articulated hairs above, glabrous beneath; veins forming copious anastomoses with included veinlets. **Sori** terminal on free included veinlets, round, usually in a single row at each side of midrib, more or less raised on upper surface; indusia up to 1 mm diam., persistent, glabrous. **Fig. 6.88**

Thailand.- All over the country.

Distribution.- N. India (type), SW. China, Indochina, Taiwan, W. Malesia to Indonesia.

Ecology.- On rather dry mountain slopes in Mixed deciuous forest or in Dry evergreen forest at 100-400 m altitudes.

Vernacular.- Kut kwang (กูดกวาง), Kut kieo (กูดเกียว), Kut sang (กูดซาง), Kut hok (กูดหก), Kut hom kha (กูดฮ่มค่า) (Northern); Chon pa (โชนป่า) (Peninsular).

Specimens examined.- BCU: Y. Yuyen 28, 152, 156; T. Boonkerd 110, 357, 1377.

3. Tectaria polymorpha (Wall. ex Hook.) Copel., Phil. J. Sci. 2C: 413. 1907; Tagawa & K. Iwats., Fl. Thailand 3(3): 378. 1988.- *Aspidium polymorphum* Wall. ex Hook., Sp. Fil. 4: 54. 1826; Bedd., Handb.: 218. 1969.

Rhizome short, ascending to suberect, scaly, scales linear-subtriangular, up to 6 by 1 mm, brown, stiff, margined with pale thinner edges. **Stipes** stramineous to brown, scaly at base, densely pubescent on adaxial surface, grabrescent beneath, up to 45-65 cm long. **Lamina** imparipinnate, ovate-oblong, up to 40-50 by 20-40 cm; rachis densely pubescent on upper surface, grabrescent beneath; lateral pinnae oblong-lanceolate, cuadate at apex, cuneate to rounded at base, shortly stalked or sessile, broadest at 1/3 way from apex, usually about 20 by 5-6 cm, subentire, or rarely coarsely dentate, terminal pinna a little larger, broadest at 2/3 way from apex, up to 26 by 8 cm; texture papyraceous, green, glabrous; costa and main veins distinctly raised beneath, shortly pubescent; veins copiously anastomosing, main areoles distinct including two rows of smaller areoles with free included veinlets, all veinlets raised beneath, grabrous. **Sori** on cross veins or sometimes on included free veins, irregularly scattered on lower surface of pinnae, round, about 1 mm diam.; indusia small, fugacious, pubescent. **Fig. 6.87**

Thailand.- NORTHERN: Chiang Rai (Mae Suai, Mae Kok, Doi Phacho), Chiang Mai (Doi Chong, Tha Ton, Khun Khong Sang, Doi Chiang Dao, Mae Son to Huai Sai), Tak (Ban Na, Ban Musoe), Phitsanulok (Thong Salaeng Luang), Nakhon Sawan (Pa Ma Kham Pom); NORTH-EASTERN: Loei (Phu Luang, Sam Phai, Phu Kradueng); CENTRAL: Nakhon Nayok (Khao Yai), Saraburi (Muak Lek); SOUTH-EASTERN: Chanthaburi (Khao Soi Dao, Khao Sabap, Takha Mao Falls); SOUTH-WESTERN: Kanchanaburi (Song Tho); PENINSULAR:Chumpon (Khao Tong), Surat

Thani (Ban Don), Nakhon Si Thammarat (Chawang), Trang (Khao Chong), Yala (Bannang Sata).

Distribution.- E. Himalaya (type) to S. China and Taiwan, South to Sri Lanka and W. Malesia.

Ecology.- On mountain slopes usually in dry places in Tropical evergreen forests at 800 m altitudes.

Vernacular.- Kut kaeo (กูดแก้ว), Kut taem (กูดแต้ม), Kut kai (กูดไก่), Kut hua lek (กูดหัวเหล็ก) (Northern); Kut hok (กูดหก) (Shan/Northern); Seng-khia-du (เซ็งเขี่ยดู่) (Karen/Northern).

Specimens examined.- BCU: Y. Yuyen 31; P. Rachata15, 131, 295; T. Boonkerd 1374.

THELYPTERIDACEAE

Holttum, Rev. Fl. Malaya 2: 236. 1955.

Rhizome usually creeping but not dorsiventral in structure. **Stipes** containing 2 vascular strands at the base, these soon uniting to form a single strand U-shaped in section. **Lamina** usually pinnatifid, rarely bipinnate; surface bearing slender unicellular hairs and sometime also short glandular hairs; veins all free, pinnately arranged in each lobe of pinnatifid fronds, or with veins of adjacent group joining to form an excurrent vein which passes to the sinus between lobes; sinuses closed at the base by a translucent membrane. **Sori** usually subapical on veins, round or somewhat elongate, usually with reniform indusium, rarely naked.

THELYPTERIS

Schmidel, Icon. Pl. ed. Keller: 45. t. 11, 13. 1763.

Rhizome radial, scaly; scales concolorous, hairy. **Stipes** bearing scales and hairs. **Lamina** bipinnate, 1-pinnate to pinnatifid, variously hairy according to species; veins pinnate, all free, or anastomosing. **Sori** round or crescentic, indusiate or naked; indusia hairy; sporangia setiferous or glabrous.

Key to the species

1. Veins anastomosing, goniopteriod or meniscioid
   2. Pinnae variously lobed, with callous membrane at sinus between lobes
      3. Aerophore absent at base of costa
         4. Sporangia glabrous
            5. Basal pair of veinlets actually anastomosing, the second basal pair running to the callous membrane
               6. Sori confined to segment, lower 1-3 pairs of veinlets commonly not soriferous; swamp ferns **5. T. interrupta**
               6. Sori not confined to segment, or basal veinlets usually soriferous; lamina pubescent; glands confined to axes **7. T. parasitica**
            5. At least one of the second basal veinlet uniting with excurrent veinlets bbelow callous sinus
               7. Under surface of lamina densely hairy, rhizome short-creeping; pinnae up to 20-25 pairs, about 2 cm wide **2. T. dentata**
               7. Under surface of lamina glabrous or subglabrous, rhizome erect; pinnae up to 18-20 pairs, about 1.8 cm wide **6. T. papilio**
         4. Sporangia setiferous, basal pinnae not hardly reduced **4. T. hirtisora**
      3. Aerophore present at junction between rachis and costa; 1.5 basal pairs of veinlets actually uniting below callous sinus **10. T. truncata**
   2. Pinnae subentire, callous membrane absent at sinus between lobes
      8. Rhizome stout, about 5 mm diam.; fronds uniform; sporangia setiferous; indusiate **1. T. aspera**
      8. Rhizome slender, about 3 mm diam.; fronds trifoliate **9. T. triphylla**
1. Veins all free
   9. Veinlets not reaching the very margin of lobe; frond tripinnatifid, up to 40-70 cm long **8. T. torresiana**
   9. Veinlets all simple, reaching the very margin of lobe; frond 1-pinnate, up to 20-9 cm long **3. T. hirsutipes**

1. <u>Thelypteris</u> <u>aspera</u> (C. Presl) K. Iwats., Mém.Coll. Sci. Univ. Kyoto B. 31: 192. 1965; Tagawa & K. Iwats., Fl. Thailand 3(3): 411.1988.- *Goniopteris aspera* C. Presl, Tent. Pterid.: 183. 1836, based on *Polypodium asperum* C. Presl, Rel. Haenk. 1: 24. t. 3. f. 4. 1825, non L. 1753.- *Doryopteris gymnopteridifrons* Hayata, Ic. Pl. Formos. 8: 148. f. 75, 76. 1919.- *Abacopteris presliana* (Ching) Ching, Bull. Fan Mém. Inst. Biol. 8: 248. 1938.- *Pronephrium asperum* (C. Presl) Holttum, Blumea 20: 112. 1972; in Fl. Mal. II. 1: 512. f. 14, g-i. 1981.- *Pronephrium gymnopteridifrons* (Hayata) Holttum, Blumea 20: 112. 1972.- *Thelypteris urophylla* auct. non (Wall. ex Hook.) K. Iwats.: Tagawa & K. Iwats., Southeast As. St. 5: 71. 1976.

Rhizome creeping, about 5 mm diam.; usually brown and naked. **Stipes** about 50 cm long, brown, hairy at upper portion, rachis densely hairy througout. **Lamina** oblong, about 40 by 25 cm; lateral pinnae about 5-6 pairs, lowest pair sometimes

reduced, upper ones larger, sessile, narrowly oblong, caudate at apex, gradually narrowing towards broadly cuneate or subtruncate base, about 20 by 3-4 cm, lobed to 1/4 way towards costa, segments obtuse at apex, oblique, cartilagineous at margin; venation menisciod; texture papyraceous, firm, pale green to green, pubescent on lower surface and glabrescent on upper surface. **Sori** in two rows, medial one close to excurrent veinlets; indusia small, persistent but usually immersed among sporangia at maturity, hairy; sporangia with few setose hairs. **Fig. 6.91**

Thailand.- NORTHERN: Lampang (Mae Ngao); NORTH-EASTERN: Loei (Phu Luang).

Distribution.- S. China, Taiwan, Malesia throughout (type from Luzon) to N. Queensland.

Ecology.- Terrestrial on rather dry slopes Tropical evergreen forest at 850 m altitudes.

Vernacular.- Kut tong (กูดตอง) (Northern).

Specimen examined.- BCU: Y. Yuyen 56; P. Rachata 130, 132; BKF: J. F. Maxwell 85-1045, 87-21, 87-775; K. Larsen et al. 42151.

2. <u>Thelypteris</u> <u>dentata</u> (Forssk.) St. John, Amer. Fern J. 26: 44. 1966; Tagawa & K. Iwats., Fl. Thailand 3(3): 427.1988.- *Polypodium dentatum* Forssk., Fl. Aegypt.- Arab.: 185. 1775.- *Cyclosorus dentatus* (Forssk.) Ching, Bull. Fan Mém. Inst. Biol. 8: 206. 1938.- *Christella dentata* (Forssk.) Brownsey & Jermy, Brit. Fern Gaz. 10: 338. 1973; Holttum, in Fl. Mal. II. 1: 557. f. 1p, 20a. 1981.- *Cyclosorus subpubescens* auct. non (Bl.) Ching; Holttum, Rev. Fl. Malaya 2: 273. f. 157. 1955.

Rhizome short-creeping or suberect, bearing a tutfed of fronds; scales oblong, gradually narrowing to apex, about 9 by 1.5 mm, pale brown. **Stipes** about 25-30 cm long, scaly at base, scattered very short spreading hairs, bearing reduced pinnae on upper portion. **Lamina** oblong-lanceolate, cuneate at apex, gradually narrowing downwards, up to 68-85cm long and 20-25 cm wide, with about 20-25 pairs of pinnae, patent or ascending, sessile, linear-lanceolate, more or less auricle at base, gradually narrowing towards long- acuminate apex the base truncate, up to 13 by 2 cm, lobed 1/2 way to costa, lower pinnae gradually becoming smaller downwards but rarely reduced to more auricles; segment oblong–subdeltoid, oblique, rounded at apex; rachis and costae rather densely clothed with spreading curved pale hairs, with similar scattered

and veins; texture herbaceous to softly papyraceous, yellow-green to green, basal veinlets and basal second anterior ones uniting below callous membrans; lower surface of frond subglabrous. **Sori** medial, round; indusia large, densely hairy. **Fig. 6.94**

Thailand.- NORTHERN: Chiang Rai (Mae Kok, Ban Nong Lu), Chiang Mai (Doi Suthep, Mae Klang), Mae Hong Son (Khun Yuam), Lamphun (Doi Khun Tan), Lampang (Mae Ang), Phrae (Mae Sai), Tak (Ban Musoe, Mae Sot), Phitsanulok (Thung Salaeng Luang); NORTH-EASTERN: Phetchabun (Phu Miang), Loei (Phu Luang, Dan Sai), Khon Khaen (Pha Nok Khao); CENTRAL: Nakhon Nayok (Khao Yai), Saraburi (Krabin, Bu Phram), Bangkok (Khlong San); SOUTH-EASTERN: Prachin Buri (Krabin, Bu Phram), Chanthaburi (Khao Soi Dao, Khao Sabap), Trat (Ko Chang); SOUTH-WESTERN: Kanchanaburi (Bang Krasai, Wangka, Phomphi, Thung Kang Yang); PENINSULAR: Surat Thani (Ban Don), Nakhon Si Thammarat (Khao Luang, Thong Song), Phangnga, Trang, Satun.

Distribution.- Pantropic (type from Arabia).

Ecology.- On rather dry mountain-slopes in Mixed deciduous forest at 300 m altitudes.

Specimen examined.- BCU: Y. Yuyen 5; P. Rachata 294; T. Boonkerd 704.

3. Thelypteris hirsutipes (Clarke) Ching, Bull. Fan Mém. Inst. Biol. 6: 314. 1936; Tagawa & K. Iwats., Fl. Thailand 3(3): 406. 1988.- *Nephrodium gracilescens* var. *hirsutipes* Clarke, Trans. L. Soc. II. Bot. 1: 514. t. 67. f. 1. 1880.- *Lastrea hirsutipes* (Clarke) Bedd., Handb. Suppl.: 52. 1892.- *Coryphoteris hirsutipes* (Clarke) Holttum in Nayer & Kaur, Comp. Bedd. Handb.: 203. 1974; in Fl. Mal. II. 1: 359. f. 4, c. 1981.

Rhizome stout, short-creeping, bearing tufted of fronds. **Stipes** stramineous, up to 20 cm long, densely hairy throughout; hairs pale, patent. **Lamina** 1-pinnate, oblong, acute at apex, up to 20 by 9 cm; pinnae about 20 pairs; lower one pinnae reflexed, middle pinnae sessile, patent, acute to acuminate at apex, up to 4.5 by 1 cm, deeply lobed 1/2 way to costa; segment oblong, rounded to obtuse at apex; rachis and costa stramineous, hairy; texture papyraceous, deep green, glabrous, hairy at margin; veins pinnate, veinlets simple, all reaching the margin of segments, hairy. **Sori** subcostular, large, up to 1 mm diam.; indusia round-reniform, persistent, hairy. **Fig. 6.92, 6.93**

Thailand.- NORTH-EASTERN: Loei (Phu Luang, Phu Kradueng); PENINSULAR: Nakhon Si Thammarat (Khao Luang).

Distribution.- E. Himalayas (type) to SW. China and W. Malesia.

Ecology.- Terrestrial fern or on muddy rocks along stream in Hill evergreen forest at 1050 m altitudes.

Specimen examined.- BCU: Y. Yuyen 46; BKF: Iwatsuki 8369; M. Tagawa, K. Iwatsuki & Fukuoka T4791; T. Smitinand 1281.

4. Thelypteris hirtisora (C. Chr.) K. Iwats., J. Jap. Bot. 38: 314. 1963; Tagawa & K. Iwats., Fl. Thailand 3(3): 418. f. 43. 1-2. 1988.- *Dryopteris hirtisora* C. Chr., Contr. U. S. Nat. Herb. 26: 277, 330. 1931.- *Cyclosorus hirtisorus* (C. Chr.) Ching, Bull. Fan Mé m. Inst. Biol. 8: 221. 1938.- *Cyclosorus validus* auct. non (H. Christ) Tardieu: Tardieu & C. Chr. in Fl. Gen. I. –C. 7(2): 398. 1941.- *Cyclosorus acuminatus* auct. non (Holttum) Nakai ex H. Ito: Holttum, Dansk Bot. Ark. 20: 22. 1961.

Rhizome long-creeping, up to 5 mm diam., bearing stipes remotely, scaly; scales brown, narrowing towards apex, up to 7 by 1.5 mm. **Stipes** about 37-42 cm long, scaly at base, hairy throughout. **Lamina** oblong or subtriangular, acute at apex with long terminal pinna, up to 35 by 30 cm; pinnae to about 7-9 pairs, the lowest pinnae hardly reduced or lower one or two pairs slightly reduced and deflexed, middle larger pinnae shortly stalked or subsessile, ascending, linear-lanceolate, gradually narrowing towards long-acumuinate apex, broadly cuneate to subtruncate at base, up to 16 by 2 cm, shallowly lobed about 1/4 way to costa; segment oblique, subdeltoid, acute at apex; texture papyraceous, rachis and costae bearing short hairs; costules and veins with scattered hairs like the costae; venation goniopteroid, basal 2-3 pairs anastomosing below callous sinus. **Sori** medial; indusia rather small, persistant but usually under sporangia in mature sori; sporangia setose. **Fig. 6.95**

Thailand.- NORTHERN: Chiang Rai (Doi Tung, Doi Phacho, Chiang Kham), Chiang Mai (Doi Suthep, Doi Chang, Doi Hua Mot, Mae Klang, Ban Yang), Tak (Ban Musoe); NORTH-EASTERN: Phetchabun (Phu Miang), Loei (Phu Luang, Phu Kradueng); SOUTH-WESTERN: Kanchanaburi (Khao Ngua).

Distribution.- SW. China, Upper Myanmar (type) and Indochina.

Ecology.- On humus-rich mountain slopes in Hill evergreen forest at 1040 m altitudes.

Specimen examined.- BCU: Y. Yuyen 203; P. Rachata 76, 116, 124, 264.

5. Thelypteris interrupta (Willd.) K. Iwats., J. Jap. Bot. 38: 314.1963; Tagawa & K. Iwats., Fl. Thailand 3(3): 400. f. 38. 8-9. 1988.- *Pteris interrupta* Willd., Phytogr. 1: 13. t. 10. 1794.- *Aspidium goggolodus* Schkuhr, Kr. Gew. 1: 193. t. 33c. 1809.- *Cyclosorus gongylodes* (Schkuhr) link, Hort. Berol. 2: 128. 1833; Holttum, Rev. Fl. Malaya 2: 261. f. 148. 1955.- *Dryoteris gongylodes* (Schhuhr) O. Ktze., Rev. Gen. Pl. 2: 811. 1891.- *Cyclosoros interruptus* (Willd.) H. Ito, Bot. Mag. Tokyo 51: 714. 1937; Holtt in Fl. Mal. II. 1: 386. f. 1, r, 7, a-c. 1981.- *Thelypteris goggilodus* (Schkuhr) Small, Fern SE. States: 248, 475. 1938.

Rhizome long-creeping, up to 5 mm diam., usually dark and naked, scaly at apex; scales caducous subdeltoid, pale brown, thin, up to 2.5 by 1 mm, glabrous. **Stipes** up to 45-60 cm long, straminous with dark base, glabrous. **Lamina** oblong-lanceolate, acute at apex, basal pinnae hardly reduced, up to 45-50 by 20 cm, 20-24 pairs of spreading or oblique pinnae; middle larger pinnae sessile, linear-lanceolate, gradually narrowing towards acute apex, broadly cuneate to subtruncate at base, up to 12 by 1.3 cm, lobed to 1/4 way towards, the costa into slightly oblique, rounded, shortly pointed lobes; upper surface glabrous; lower surface of costae with or without short spreading hairs; always with small broadly ovate thin brown deciduous scales; costules and veins beneath glabrous or more or less densely clothed hairs like the costae and usually with round orange glands; veins pinnate, 8 pairs, the lowest spreading and anastomosing with corresponding veins of adjacent groups; forming a long excurrent vein runing to the sinus. **Sori** confined to segments, usually confluent at maturity; indusia hairy, caducous. **Fig. 6.96**

Thailand.- NORTHERN: Phayao, Chiang Mai (Mae Klang), Lampang (Mae Toi); CENTRAL: Bangkok; SOUTH-WESTERN: Prachuap Khirikhan (Sam Roi Yot); PENINSULAR (Thung Song), Phatthalung, Song Khla, Krabi (Khao Phanom), Phuket (Ko Yao Yai, Khun Talao Lake), Yala (Bannang Sata).

Distribution.- Pantropic (type from India).

Ecology.- On grassy banks along streams or in open marshy places in Mixed deciduous forest at 180 m altitudes.

Specimen examined.- BCU: Y. Yuyen 18; BKF: J. F. Maxwell 86-879; Winit 1050.

6. **Thelypteris papilio** (Hope) K. Iwats., Mém. Coll. Sci. Univ. Kyoto B. 31. 175. 1965; Tagawa & K. Iwats., Fl. Thailand 3(3): 428. 1988.- *Nephrodium papilio* Hope, J. Bomb. Nat. Hist. Soc. 12: 625. t. 12. 1899.- *Cyclosorus papilio* (Hope) Ching, Bull. Fan Mém. Inst. Biol. 8: 214. 1938.- *Christella papilio* (Hope) Holttum in Nayar & Kaur, Comp. Bedd. Handb.: 208. 1974; in Fl. Mal. II. 1. 556. f. 20 d-e. 1981.

Rhizome short, suberect, ascending, with a tuft of fronds; scales narrow, gradually narrowing towards apex, about 7 by 1 mm, pale brown, hairy. **Stipes** about 36-50 cm long, scaly at base, with very short spreading hairs throughout, bearing reduced pinna on upper portion. **Lamina** oblong-lanceolate, acuminate at apex, gradually narrowing downwards, up to 54-62 by 25 –35 cm, with about 18-20 pairs of pinna, the lowest 1-2 pairs gradually reduced and deflexed, butterfly-shaped or more auricles, middle larger pinna sessile, patent or ascending, linear-lanceolate, gradually narrowing towards long acuminate apex, up to 14-18 by 1.8-2 cm, lobed 1/4 way to costa; lower pinnae gradually becoming smaller downwards but rarely reduced to auricles; segment oblong-subdeltoid, oblique, round at apex, pubescent at margin; rachis and costae rather densely clothed with spreading, curved pale hairs, with similar scattered hairs on costules and veins; texture herbaceous to softly papyraceous, green; basal veinlets 3 pairs and forth anterior ones uniting below callous membrane; lower surface of frond subglabrous. **Sori** medial, round; indusia, larger, sparsely hirsute. **Fig. 6.97**

Thailand.- NORTHERN: Chiang Mai (Doi Inthanon, Doi Suthep); SOUTH-WESTERN: Kanchanaburi (Khao Ngi Yai).

Distribution.- Sri Lanka, Himalayas (type), Taiwan, and Malaysia.

Ecology.- On moist ground by streamlets in Dry evergreen forest or Hill evergreen forest at 700 –1040 m altitudes.

Specimen examined.- BCU: Y. Yuyen 33, 83; P. Rachata 269, 286, 292.

7. **Thelypteris parasitica** (L.) Fosberg, Occ. Pap. B. P. Bishop Mus. 23: 30. 1962; Tagawa & K. Iwats., Fl.Thailand 3(3): 424.1988.- *Polypodium parasiticum* L., Sp. Pl. 2: 1090. 1753.- *Dryopteris parasiticum* (L.) O. Ktze., Rev. Gen. Pl. 2: 811. 1891.- *Aspidium parasitichum* (L.) H. Christ, Bot. Tidsskr. 24: 109. 1901.- *Nephrodium amboinense* auct. non Pr.: Hosseus, Beih. Bot. Centr. 28(2): 365. 1911.- *Christella parasitica* (L.) Lev., Fl. Kouy-Tcheou: 475. 1915; Holttum in Fl. Mal. II. 1: 559. f.

20f. 1981.- *Cyclosorus parasiticus* (L.) Farw., Amer. Midl. Nat. 12: 259. 1929; Holttum, Rev. Fl. Malaya 2: 231. f. 162. 1955.

Rhizome creeping, about 5 mm diam.; scales narrow, up to 5 by 1 mm, brown. **Stipes** about 29 cm long, stramineous, scaly at base, clothed throughout with scattered pale spreading hairs. **Lamina** oblong-lanceolate, acute at apex, about 45 by 18 cm; basal pinnae deflexed, lower pinnae patent or ascending, linear-lanceolate, truncate at base acuminate at apex and toothed almost throughout, sessile, about 11 by 1.5 cm, lobed more than half-way towords costa; segments oblong, oblique, rounded at apex, entire at margin; rachis, costae, costules and veins, both above and below, clothed more or less densely with spreading needle-like pale hairs; texture papyracecus, yellow-green to green, hairy on both surface; basal pairs of veins anastomosing, the other veinlets running to margin of lobes, glandular sessile usually present on the costules and veins beneath, rod-shaped, yellow to orange. **Sori** supramedial, usually not on lobes, i.e. on one or two basal veinlets; indusia persistent, hairy. **Fig. 6.98**

Thailand.- NORTHERN: Chiang Rai (Doi Tung, Mae Kok), Chiang Mai(Mae Hok, Doi Chiang Dao, Wang Tao, Doi Saket, Doi Suthep, Mae Klang, Pha Mon), Lampang (Mae Ngao), Tak (Mae Sod), Phitsanulok (Thung Salaeng Luang); NORTH-EASTERN: Loei (Phu Kradueng), Chaiyaphum (Nam Phrom); SOUTH-EASTERN: Chon Buri (Si Racha), Trat (Ko Chang); PENINSULAR: Surat Thani (Ban Don, Ban Huai Tha), Nakhon Si Thammarat (Khiriwong), Phangnga, Trang, Satun.

Distribution.- Tropics and Subtropics in Asia (type from S. China), north to S. Japan and South to New Zealand.

Ecology.- On rather dry slopes along path in open places along streams in Mixed deciduous forest or in Dry evergreen forest at 100-400 m altitudes.

Specimen examined.- BCU: Y. Yuyen 109; P. Rachata 140, 285; T. Boonkerd 290, 746.

8. Thelypteris torresiana (Gaud.) Alston, Lilloa 30: 111. 1960; Tagawa & K. Iwats., Fl. Thailand 3(3): 398. 1988.- *Polystichum torresianum* Gaud. In Freyc., Voy. Bot.: 333. 1817.- *Lastrea tenericaulis* (Wall.) T. Moore, Ind. Fil.: 99. 1858; Bedd., Handb.: 266. 1969.- *Aspedium setigerum* auct. non (Bl.) Kuhn: H. Christ, Bot. Tidsskr. 24: 108. 1901.- *Thelypteris uliginosa* (Kunze) Ching, Bull. Fan Mém. Inst. Biol. 6: 342. 1936;

Holttum, Rev. Fl. Malaya 2: 241. 1955.- *Macrothelypteris torresiana* (Gaud.) Ching, Acta Phytotax. Sin. 8: 310. 1963; Holttum in Fl. Mal. II. 1: 348. f. 2, h-j. 1981.

Rhizome stout, suberect, scaly at apex; scales, brown, up to 12 by 0.5 mm, hairy on dorsal surface as well as margin, the base often a few cells thick. **Stipes** up to 44-60 cm long, about 0.2-0.5 cm diam. near base, sometimes spinose in lower part. **Lamina** oblong to oblong-ovate, tripinnatifid, up to 40-70 by 20-47 cm; pinnae oblong-lanceolate, acuminate at apex, up to 15-25 by 5-8 cm, shortly stalked; larger pinnules sessile, 0.6 long-lanceolate, acuminate at apex, up to 3.5-5 by 1-1.5 cm; ultimate segments oblong, oblique, round to moderate acute at apex, lobed to 3/4 way towards midrib; serate at margin, sometimes involute; rachis terete, glabrous on lower portion, groove and hairy on upper portion; pinna-rachis hairy on upper surface, grabrous on lower surface, costules winged throughout, hairy; veins in the segments pinnate sometime forked, all free, hairy; surface hairy with unicellular or multicellular hairs; texture herbaceous to softly papyraceous, green but often brownish when dry. **Sori** round, usually close to midrid of ultimate segment; indusia small, round-reniform, hairy, thin. **Fig. 6.99**

Thailand.- NORTHERN: Chiang Rai, Chiang Mai (Doi Chiang Dao, Bo Luang, Doi Saket, Mae Klang, Pha Mon), Lampang, Lamphun (Doi Khun Tan), Tak (Ban Musoe); CENTRAL: Nakhon Nayok (Khao Yai); SOUTH-EASTERN: Trat (Ko Chang); SOUTH-WESTERN: Kanchanaburi (Sai Yok); PENINSULAR: Chumphon, Surat Thani (Ban Don), Nakhon Si Thammarat (Khao Luang), Satun, Yala (Betong).

Distribution.- Mascarene Island, throughout tropical Asia (type from Mariana Island), Polynesia, Hawaii, north to Japan and south to Australia, also naturalized in the New World.

Ecology.- On sunny slopes or shaded places along stream in Dry evergreen forest at 200 m altitudes.

Specimen examined.- BCU: Y. Yuyen 14, 19, 98, 121; P. Rachata 237.

9. Thelypteris triphylla (Sw.) K. Iwats.var. **triphylla**, Mém. Coll. Sci. Univ. Kyoto B. 31: 190. 1965; Tagawa & K. Iwatts., Fl. Thailand 3(3). 414. 1988.- *Meniscium triphyllum* Sw., Schrad. J. Bot. 1800 (2): 16. 1801; Bedd., Handb.: 397. f. 231. 1969.- *Dryopteris triphylla* (Sw.) C. Chr., Ind. Fil.: 298. 1905.- *Cyclosorus triphyllus* (Sw.) Tardieu ex Tardieu & C. Chr., Notul. Syst. 7: 77. 1938.- *Abacopteris triphylla* (Sw.)

Ching, Bull. Fan Mém. Inst. Biol. 8: 241. 1938; Holttum, Rev. Fl. Malaya 2: 287. f. 166. 1955.- *Pronephrium triphyllum* (Sw.) Holttum, Blumea 20: 122. 1972; in Fl. Mal. II. 1.: 534. f. 16 K-I. 1981.

Rhizome slender, long-creeping, about 3-4 mm diam.; scales narrow, up to 3 by 0.5 mm, brown, hairy. **Stipes** slender, covered with short hairs throughout, dark scaly base those of fertile fronds commonly more than twice as long as those of sterile fronds; about 5-11 cm long of sterile frond and 12-22 cm long of fertile frond, stramineous. **Lamina** trifoliolate, the lateral leaflets opposite to subopposite, terminal pinna the largest, oblong-lanceolate, caudately acuminate apex, cuneate to round at base, 13 by 3 cm, subentine or irregularly undulate, lateral pinnae in one pair, more or less falcate, caudate at apex, cuneate to round at base, 5-7 by 1.5-2 cm; venation meniscioid, the midrib on the upper surface shortly hairy, the rest of the upper surface glabrous; the midrib and veins beneath bearing numerous short spreading pale hooked hair; texture papyraceous,deep green. **Sori** elongate along united veinlets, crescent-shaped, naked; sporangia setiferous. **Fig. 6.89, 6.90**

Thailand.- NORTHERN: Chiang Rai, Phitsanulok (Nakhon Thai); NORTH-EASTERN: Loei (Phu Kradueng), Nong Khai; CENTRAL: Nakhon Nayok (Khao Yai); SOUTH- EASTERN: Chon Buri (Si Racha), Chanthaburi (Khao Sabap), Trat (Ko chang, Huai Raeng); PENINSULAR: Ranong (Kapoe, Muang Laen), Phangnga (Tha Nun), Narathiwat (Waeng).

Distribution.- Tropic of Asia to Australia, north to Southern edge of Japan.

Ecology.- On humus-rich in Tropical evergreen forest at 800 m. altitudes.

Specimen examined.- BCU: Y. Yuyen 195; T. Boonkerd 747, 1381; T. Seelanan 5; S. Sudee 288.

10. Thelypterris truncata (Poir.) K. Iwats., Mém. Coll. Sci. Univ. Kyoto B. 31: 33. 1964; Tagawa & K. Iwats., Fl. Thailand 3(3): 420. 1988.- *Polypodium truncatum* Poir. in Lamk., Enc. 5: 534. 1804.- *Nephrodium truncatum* (Poir.) C. Presl, Tent. Pterid.: 81. 1836; Bedd., Handb.: 280. f. 143. 1969.- *Cyclosorus trucatus* (Poir.) Tardieu ex Tardieu & C. Chr., Notul. Syst. 7: 78. 1938; Holttum, Rev. Fl. Malaya 2: 266. f. 152. 1955.- *Pneumatopteris truncata* (Poir.) Holttum, Blumea 21: 314. 1937; in Fl. Mal. II. 1: 429. f. 11 d-f. 1981.

Rhizome short, erect, bearing a tuft of fronds; scales brown, thin, up to 1.5 by 4 mm, consisting of large cell, hairy. **Stipes** pale when dry, usually up to 50-55 cm long, dark brown and scaly at base, pubescent, when old glabrous like the rachis, bearing reduced pinnae in upper part. **Lamina** oblong-lanceolate, about 80-100 cm or more long, 40 cm wide, with 35 or more pairs of pinnae fully developed; lower pinnae suddenly reduced to mere auricles, middle pinnae larger, straight, ascending, up to 20-25 by 2-2.5 cm, lobed to 1/3 way towards costa, linear, gradually narrowing towards long-acuminate apex, broadly cuneate or trucate at sessile base, nearly dentate; the costae above bearing usually a few short hairs; texture papyraceous, green, verrucose on lower surface, glabrous; veins pinnate, a few pairs of basal veinlets anastomosing, free ones ending in teeth at margin of segments. **Sori** medial, forming two parallel rows not far from the costule; indusia pale, glabrous, persistent. **Fig. 6.100**

Thailand.- NORTHERN: Chiang Rai (Mae Kok, Doi Tung, Mae Lao, Doi Phacho), Chiang Mai (Doi Phahom Pok, Doi Chiang Dao, Doi Suthep, Mae Klang), Mae Hong Son (Mae La Noi), Lamphun (Doi Khun Tan), Tak (Ban Musoe), Phrae (Mae Sai, Huai Hok), Phitsanulok (Thung Salaeng Luang); NORTH-EASTERN: Loei (Phu Luang); SOUTH-EASTERN: Chanthaburi (Khao Soi Dao); PENINSULAR: Krabi (Phanom Bencha), Surat Thani (Ban Don), Nakhon Si Thammarat (Khao Luang), Trang (Khao Chong), Yala (Khao Kala Khiri).

Distribution.- Sri Lanka, S. India, Himalayas to S. China, Myanmar, Indochina, Ryukyu Island, Taiwan, W. Malesia to Philippines.

Ecology.- On wet ground along stream in light or deep shade in Dry evergreen forest or Hill evergreen forest at 160-1050 m altitudes.

Vernacular.- Kut kan daeug (กูดก้านแดง) (Northern).

Specimen examined.- BCU: Y. Yuyen 101; P. Rachata 133, 138, 146, 218.

WOODSIACEAE

(Diels) Herter, Rev. Sudam. Bot. 9: 14. 1949; Kramer, The families and Genera of vascular Plants Vol. 1. 101. 1990.– *Athyroidae* Holttum, Rev. Fl. Malaya 2: 539. 1955.

Terrestrial fern, **Rhizome** erect or creeping; scales pale to dark, entire or toothed. **Lamina** simple to bipinnate; veins usually free, anastomosing in a few species. **Sori** usually elongate along veins, with narrow indusia.

DIPLAZIUM

Sw., Schrad. J. Bot. 1800(2): 61. 1801.- *Callipteris* Bory in Belanger, Voy.: 282. 1804.- *Athyrium* Roth, Rom. Mag. 2(1): 105. 1799.

Rhizome creeping to erect, scaly; scales entire or toothed. **Lamina** simple to pinnately compound; veins pinnate to reticulate to form rather quadrangular areoles at each side of veinlets. **Sori** elongate along veins; indusia crescentic, often adjacent to the next ones, opening to opposite direction.

Key to the species

1. Vein all free; frond pinnate to bipinnate or more compound
    2. Frond pinnate
        3. Rhizome short, erect to suberect, gemmae absent
            4. Rhizome erect; pinnae usually less than 3.5 cm wide
                5. Lateral pinnae about 7 pairs, 3.5 cm wide; viviparous **1. D. bantamense**
                5. Lateral pinnae about 20-22 pairs, 2 cm wide; usually viviparous at apical portion **2. D. crenatoserratum**
            4. Rhizome suberect; pinnae 4-4.5 cm wide, apical pinnae deeply lobed towards costa **D. sp.**
        3. Rhizome creeping; gemmae at junction between rachis and costa absent **4. D. donianum**
    2. Frond bipinnate or more compound
        6. Pinnules more or less stalked, usually 2 cm wide or more
            7. Lobes oblong with rounded apex half-way to costules, pinnules long stalk; veinlets simple or forked **3. D. dilatatum**
            7. Lobes subquadrangular with obtuse apex 1/4 way to costules; pinnules shortly stalked; veinlets all simple **7. D. simplicivenium**
        6. Pinnules sessile, most or all adnate at base, about 1-1.5 cm wide **6. D. petri**
1. Veins anastomosing; frond bipinnate **5. D. esculentum**

1. Diplazium bantamense Blume, En. Pl. Jav.: 191. 1828; Tagawa & K. Iwats., Fl. Thailand 3(3): 455. 1988. – *Athyrium bantamense* (Bl) Milde., Bot. Zeit. 353. 1870; Holttum, Rev. Fl. Malaya 2: 558. f. 330. 1955.

Rhizome erect, bearing a few fronds, densely rooted at base, scaly at apex; scales dark brown, up to 6 by 1.5 mm, irregularly minutely toothed at margin. **Stipes** up to 45 cm long, stramineous with dark brown scaly in basal portion, grooved above. **Lamina** imparipinnate, oblong with acute at apex, about 56 by 30 cm, lateral pinnae about 7 pairs, upper ones smaller, ascending, shortly stalked, oblong, gradually

narrowing towards long acuminate apex, rounded to cuneate at base, up to 17 by 3.5 cm in middle, serrate towards apex; vein several times forked, all free; texture chartaceous, green to deep green, paler below. **Sori** elongate along veins, longest on basal acroscopic veinlets, usually on both sides of veins; indusia thin, brown. **Fig. 6.101**

Thailand.- PENINSULAR: Surat Thani (Khao Khieo range), Nakhon Si Thammarat (Khao Luang), Trang (Khao Chong), Yala (Ban Chana, Ban Malao, Bannang Sata).

Distribution.- W. Malesia (type from Java).

Ecology.- On mountain slopes near streams in Tropical evergreen forests at 800-1000 m altitudes.

Specimens examined.- BCU: Y. Yuyen 190; BKF: E. Hennipman 3784; Larsen et al 313.

2. Diplazium crenatoserratum (Blume) T. Moore, Ind. Fil.: 121. 1859; Tagawa & K. Iwats., Fl. Thailand 3(3): 459. 1988. – *Asplenium crenatoceratum* Bl., En. Pl. Jav.: 117. 1828.- *Athyrium crenatoserratum* (Bl.) Milde, Bot. Zeit. 353: 1870; Holttum, Rev. Fl. Malaya 2: 561. f. 332. 1955.

Rhizome short, erect; scaly scales narrow, up to 9 by 1 mm, concolorous, dark brown, irregularly toothed at margin. **Stipes** up to 37 cm long, stramineous with dark scaly base, upper portion glabrous, grooved above. **Lamina** simply pinnate, commonly about 48 by 20 cm, narrowly oblong-subtriangular, attenuate towards apex, widest at base, pinnate without distinct terminal pinna; rachis grooved above, minutely hairy, usually viviparous at apical portion; lateral pinnae about 20-22 pairs, close, the upper adnate, grading in to the lobed deltoid apical lamina, lower ones stalked, upper pinnae sessile, narrowly oblong, acuminate at apex, distinctly auricled at acroscopic and cuneate at basiscopic bases, up to 11 by 2 cm, lobe to 1/3-1/4 way to costa or nearly entire; texture softly chartaceous, green; vein pinnate with simple veinlets, glabrous. **Sori** practically on all veinlets, diplazoid usually only on basal anterior ones; indusia thin but firm, persistent. **Fig. 6.102**

Thailand.- PENINSULAR: Surat Thani (Ban Don, Klong Ton), Nakhon Si Thammarat (Khao Luang, Khao Huai Pampur, Chawang), Satun, Yala (Klong Bla Hot, Ban Mae Prik, Betong).

Distribution.- Malesia (type from Java).

Ecology.- On moist mountain slopes or along stream in Tropical evergreen forests at 800 m altitudes.

Specimens examined.- BCU: Y. Yuyen 34, 175; Ch. Apasutaya 113A; T. Boonkerd 1536.

3. Diplazium dilatatum Blume, En. Pl. Jav.: 194. 1828; Devol and Kuo, Fl. Taiwan vol 1. 2 nd ed. 463. pl. 165. 1980; Tagawa & K. Iwats., Fl. Thailand 3(3): 464. 1988.- *Aspenium maximum* D. Don, Prod. Fl. Nepal. 8: 1825.- *Athyrium dilatatum* (Bl.) Milde, Bot. Zeit. 353. 1870; Holttum, Rev. Fl. Malaya 2: 574. f. 341. 1955.- *Asplenium bellum* Clarke., Trans. L. Soc. II. Bot. 1: 496. t. 63. f. 2. 1880.- *Diplazium meximum* (D. Don) C. Chr., Ind. Fil.: 253. 1905.- *Asplenium umbrosum* var. *bellum* (Clarke) Hosseus, Beih. Bot. Centr. 28(2): 364. 1911.

Rhizome massive, erect; scales dark brown, black-margin, up to 18 by 1 mm, toothed throughout. **Stipes** about 70 cm long, stramineous with dark basal portion, sparsely scaly throughout, densely scaly at apex, grooved above. **Lamina** subdeltoid, about 72 by 66 cm, bipinnate; rachis with minute scales, grooved above; lower pinnae with stalks up to 5 cm long, gradually narrowing towards acute apex, up to 40 by 24 cm; larger pinnules oblong-subdeltoid, long acuminate at apex, shortly stalked, lobed halfway to costule or more, up to 13 by 2 cm; lobes oblong, round to moderate acute at apex, subcordate to truncate at base, serrate, up to 7 mm broad; texture solfly papyraceous, green, paler beneath; veins pinnate with 5-8 pairs of simple or veinlets forked. **Sori** usually along posterior half of veinlets, submarginal, up to 2.5-3 mm long; indusia thin but firm, persistent. **Fig. 6.103**

Thailand.- NORTHERN: Chiang Rai (Doi Pacho, Mae Kok), Chiang Mai (Doi Chiang Dao, Doi Khun Huai Pong, Doi Suthep, Kang Kat, Doi Inthanon), Phitsanulok (Thung Salaeng Luang, Phu Rom Rot), Tak (Ban Musoe); NORTH-EASTERN: Phetchabun (Phu Miang), Loei (Phu Luang, Phu Kradueng); EASTERN: Chaiyaphum (Thung Kramang), Nakhon Ratchasima (Khao Laem); CENTRAL: Nakhon Nayok (Khao Yai); SOUTH-EASTERN: Chanthaburi (Khao Soi Dao); PENINSULAR: Surat Thani (Khao Khieo range), Trang (Khao Chong).

Distribution.- India, Myanmar, S China, Taiwan, Ryukyu, S Japan, Indochina, Malesia throughout (type from Java) to N Australia.

Ecology.- On mountain slopes in Tropical evergreen forest at 800 m altitudes.

Specimens examined.- BCU: Y. Yuyen 191; T. Boonkerd 1213, 1339.

4. Diplazium donianum (Mett.) Tardieu, Aspl. Tonkin: 58. t. 5. 1932; Devol and Kuo, Fl. Taiwan vol 1. 2 nd ed. 465. 1980; Tagawa & K. Iwats., Fl. Thailand 3(3): 455. f. 48. 4. 1988.- *Asplenium donianum* Mett., Fil. Lechl.: 177. 1859.- *Athyrium bantamense* auct. non (Bl.) Milde: Bedd., Handb.: 177. f. 86. 1969.

Rhizome creeping, 3-5 mm diam, blackish, scaly on younger part; scales narrow, about 6 by 1.5 mm, concolorous, darkbrown to nearly black, minutely toothed at margin. **Stipes** up to 40 cm long, stramineous to brownish, darker in lower portion, grooved on adaxial surface. **Lamina** imparipinnate, oblong in outline, acute at apex, about 37 by 27 cm; rachis grooved on upper surface; lateral pinnae 3 pairs, stalks distinct in lower portion, about 5-7 mm long, oblong-lanceolate, cuneate at base, gradually narrowing toward, acuminate apex, subentire or serrate at posterior portion, up to 20 by 4-4.5 cm; texture coriaceous or fleshy, green to deep green; rachis like those stipe, never gemmiferous, surface glabrescent, costa raised below grooved on upper surface; veins several times forked, all free. **Sori** usually elongate along veinlets, longest on basal acroscopic veinlets, about 2 cm long; indusia thin but firm, brown. **Fig. 6.104**

Thailand.- NORTHERN: Chiang Mai (Doi Suthep), Tak (Doi Musoe), Phitsanulok (Thung Salaeng Luang); NORTH-EASTERN: Loei (Phu Kradueng); CENTRAL: Nakhon Nayok (Khao Yai); SOUTH-EASTERN; Trat (Ko Chang); PENINSULAR: Nakhon Si Thammarat (Khao Luang, Ron Phibun, Khiriwong).

Distribution.- N. India (type) to S. China and Taiwan, north to S. Japan, south to Indochina.

Ecology.- On mountain slopes in light shade in Tropical evergreen forest to Hill evergreen forest at 900-1060 m altitudes.

Specimens examined.- BCU: Y. Yuyen 43; BKF: K. Iwatsuki & N. Fukuoka 7392; M. Tagawa et al T4528.

5. Diplazium esculentum (Retz.) Sw., Schrad. J. Bot 1801 (2): 312. 1803; Tagawa & K. Iwats., Fl. Thailand 3(3): 466. 1988.- *Hemionitis esculenta* Retz., Obs. Bot.: 3. 1791.- *Anisogonium esculentum* (Retz.) C. Presl, Tent. Pterid.: 116. 1836; Bedd., Handb.: 192. f. 94. 1969; Devol and Kuo, Fl. Taiwan vol 1. 2 nd ed.: 442. pl. 157.

1980.- *Athyrium esculentum* (Retz) Copel., Phil. J. Sci. Bot. 3: 295. 1908; Holttum, Rev., Fl. Malaya 2: 562. f. 333. 1955.

Rhizome erect, densely scaly at apex, bearing a tulf of fronds; scales dark brown, black-margin, up to 10 by 1 mm, gradually narrowing at apex, minutely toothed throughout. **Stipes** about 40 cm long, stramineous, dark brown at base, scaly at base like those on rhizome, grooved above. **Lamina** very variable in size, about 120 by 50 cm, bipinnate; lower 1 or 2 pinnae often reduced, larger pinnae up to 29 by 15 cm, rather suddenly narrowing acuminate at apex, with 5 mm stalked; larger pinnules oblong-lanceolate, subsessile, subtruncate or auricled at base, narrowing towards acuminate at apex, up to 8 by 2 cm; costa and costules grooved in ridges; minutely lobes at margin, round at apex, serrate; texture papyraceous, greenished, paler beneath; veins anastomosing, veinlets up to 10 pairs, uniting with the opposite ones forming excurent veinlets. **Sori** elongate, on nearly the whole length of veinlets, often uniting opposite ones; indusia thin, pale brown. **Fig. 6.105**

Thailand.- NORTHERN: Chiang Rai (Mae Kok), Chiang Mai (Fang, Ban Mae Kon, Mae Klang, Kong Kat, Sop Aep), Mae Hong Son (Mae La Noi, Mae Su Rin), Lampang, Tak; EASTERN: Chaiyaphum (Nam Phrom); CENTRAL: Nakhon Nayok (Khao Yai), Saraburi (Muak Lek), Krung Thep (Bangkok); SOUTH-EASTERN: Chonburi (Si Racha); SOUTH-WESTERN: Kanchanaburi (Kroeng Kawia, Phomphi, Sai Yok); PENINSULAR: Surat Thani (Khao Pok, Ban Don), Satun, Narathiwat (Waeng).

Distribution.- Tropics of Asia, north to Central China and S. Japan, east to S. Pacific Islands.

Ecology.- Terrestrial fern occurs along streams in open or light shade in Dry evergreen forest at 130 m altitudes.

Uses.- Young fronds locally consumed as vegetable as well as on sale in the market.

Vernacular.- Hat sadam (หัสดำ) (Peninsular); Kut kin (กูดกิน) (Northern).

Specimens examined.- BCU: Y. Yuyen 119; P. Rachata 202, 208; T. Boonkerd 17.

6. Diplazium petri Tardieu, Aspl. Tonkin: 67. pl. 9, 1-2. 1932; Devol and Kuo, Fl. Taiwan vol 1. 2 nd ed. 467. 1980; Tagawa & K. Iwats., Fl. Thailand 3(3): 461. 1988.- *Diplazium triangular* Tagawa., Acta Phytotax. Geobot. 7: 79. 1938.- *Athyrium petri* (Tardieu) Ohwi., Fl. Jap. 88. 1965.

Rhizome short, suberect, bearing a tulf of large fronds, scaly at apex; scales dark brown, up to 9-10 by 1 mm, toothed at margin. **Stipes** about 30 cm long, green to stramineous with dark basal portion, grooved above. **Lamina** subtriangular, long acuminate apex, about 60 by 42 cm, bipinnatifid to tripinnate; pinnae stalked, about 10 pairs, basal pinnae the largest, oblong with acuminate apex, about 21 by 11 cm, with stalks of about 3 cm long, upper pinnae gradually becoming smaller upward; pinnules up to 1-1.5 by 3-3.5 cm, narrowing toward acuminate apex, cordate to deccurent at base, lobed to 1/3 way towards costules, oblique, slightly falcate, margin serrate, apex round to subacute; texture chartaceous, deep green; veins pinnate with 2-4 pairs of simple veinlets. **Sori** 2-3 mm long, usually on basal veinlets, crescentic or diplazoid; indusia brown, thin but firm. **Fig. 6.106**

Thailand.- SOUTH-EASTERN; Chanthaburi (Khao Soi Dao, Pong Nam Ron); PENINSULAR: Nakhon Si Thammarat (Khao Luang).

Distribution.- Indochina (type), Ryukyu, and Taiwan.

Ecology.- On rather dry mountain slopes in Hill evergreen forest at 1040 m altitudes.

Specimens examined.- BCU: Y. Yuyen 95; P. Rachata 199; BKF: K. Iwatsuki et al 8387.

7. Diplazium simplicivenium Holttum, Gard. Bull. S. S. 11: 100. 1940; Tagawa & K. Iwats., Fl. Thailand 3(3): 464. 1988.- *Athyrium simplicivenium* (Holttum) Holttum, Rev. Fl. Malaya 2: 573. f. 340. 1954.

Rhizome massive, erect bearing a tuft of fronds, scaly at apex; scales linear-lanceolate, about 15 by 1 mm, brown, black-margined, toothed. **Stipes** up to 60-100 cm long, about 1.5-2 cm diam near base, stramineous to brown, dark in lower portion, scaly at base. **Lamina** about 85 by 70 cm, bipinnate, subdeltoid, lower pinnae about 30 by 12 cm, narrow oblong with acute apex; larger pinnules shortly stalked or subsessile, narrowly oblong-subtriangular, gradually narrowing towards a long acuminate apex, broadly cuneate to subtruncate or subcordate at base, usually shallowly lobed, up to 9

by 2 cm; lobes subquadrangular, 1/4 way to costules, obtuse at apex, subentire 5-8 mm in breadth; texture softly papyraceous, pale green; vein pinnate with 4-6 pairs of simple veinlets; veinlets hardly reaching the margin of lobes, basal anterior ones stopping far below the sinus. **Sori** along veinlets, about 8 mm long, indusia rather thick, pale. **Fig. 6.107, 6.108**

Thailand.- SOUTH-WESTERN; Kanchanaburi (Khao Ngi Yai), Uthai Thani (Ban Rai); PENINSULAR: Surat Thani (Klong Ton), Nakhon Si Thammarat (Khao Luang), Phangnga (Khao Pok), Trang (Khao Chong), Satun, Yala (Muang Wing).

Distribution.- Malaysia (type) and probably also in Borneo.

Ecology.- On moist mountain slopes in Dry evergreen forest or in Tropical evergreen forest at 130-280 m altitudes.

Specimens examined.- BCU: Y. Yuyen 21, 119; C. Apasutaya 122; P. Rachata 288; T. Boonkerd 534; BKF: M. Tagawa & T. Yumada T202; M. Tagawa et al T6982.

8. <u>Diplazium</u> sp.

Rhizome suberect or short-creeping, blackish, scaly; scales narrow, up to 7 by 1 mm, brown edges finely toothed oblong with acuminate apex. **Stipes** stramineous black at base, grooved above, 50 cm long. **Lamina** imparipinnate, oblong in outline, about 56 by 40 cm, pinnae 4-5 pairs, apical pinnae deeply lobed, lobed at base; lateral pinnae about 20-27 by 4.5 cm; stalked, up to 1-1.5 cm long, oblong acuminate, base very unequal; basiscopic half round, acroscopic cuneate; edge broadly crenate or lobed to deep of 3-4 mm in basal part, crenate towards apex; texture chartaceous, deep green pale below; vein all free. **Sori** in small group of vein, corresponding to the crenate or lobes of the margin, the first branch of each group running to the margin and bearing a diplazoid sorus on more than 3/4 of its length, the other sori much shorter. **Fig. 6.109**

Thailand.- SOUTH-WESTERN: Prachuap Khiri Khan (Khao Luang)

Distribution.-

Ecology.- On moist mountain slopes in Tropical evergreen forests at 880 m altitudes.

Specimens examined.- BCU: Y. Yuyen 76.

Note.- This specimen closes to *Diplazium bantamense* Blume but different in rhizome creeping; apical pinnae deeply lobed.

ORDER DAVALIALES

DAVALIACEAE

Devol & Yang., Fl. Taiwan vol. 1. 2nd ed.: 270. 1980.

Rhizome long creeping, fleshy, covered with peltate-based scales. **Stipe** smooth, jointed to the rhizome. **Lamina** broadly triangular in outline finely dissected, all veins free. **Sori** terminal on the veins, with a basal indusium, sometime attached along it side or at the base only.

Key to the genera

1. Indusia attached by base only, or rarely also by a little above the base, or exindusiate
   2. Frond coriaceous, small **2. Humata**
   2. Frond herbaceous, large **3. Leucostegia**
1. Indusia attached by base and side **1. Davallia**

1. DAVALLIA

J. E. Smith. Mém. Acad. Turin. 5: 414. 1793.

Rhizome long-creeping, thick, densely scaly with peltate or cordate scales. **Stipes** naked, articulate to rhizome. **Lamina** finely dissected, usually deltoid; texture chartaceous to coriaceous. **Sori** round, terminal on veins; indusium attached by base side, cup-shaped.

Key to the species

1. False veinlets present between true veins; frond quadripinnate; rhizome up to 5 mm in diam. **1. D. denticulata**
1. No false veins present; frond tripinnate; rhizome up to 6-12 mm in diam. **2. D. solida**

1. Davallia denticulata (Burm. f.) Mett. ex Kuhn, Fil. Deck.: 27. 1867; Holttum, Rev. Fl. Malaya 2: 359. f. 206. 1955; Tagawa & K. Iwats., Fl. Thailand 3(2): 160. 1985.- *Adiantum denticulatum* Burm. f., Fl. Ind.: 236. 1768.- *Davallia elegans* Sw., Schrad. J. Bot. 1800 (2): 87. 1801; Bedd., Handb.: 59. 1969.

Rhizome long-creeping, about 5 mm diam., densely scaly throughout, scales ovate at base and abruptly narrowing to long, patent tails, the base up to 1 mm wide

and 1.5 mm long, more or less appressed, tails up to 5 by 0.2 mm, brown to dark brown, ciliate at margin. **Stipes** brown, terete, up to 35 cm long, glabrous. **Lamina** quadripinnatifid to quadripinnate, subtriangular, broadly cuneate at base, up to 40 cm long, 25 cm wide; main rachis some what flexuous; stalked distinct, about 3 cm long; pinnules and secondary pinnules stalked or upper smaller one subsessile, oblong to oblong-subdeltoid; moderate acute to acuminate, ultimate segment (3^{rd} pinnules) oblong, oblique, round at apex, narrowly cuneate and decurrent at base, lobed at margin, lobes acute, about 1 mm broad, thin but fairly stiff, green; vein distinct on the lower surface; false veinlet present between true veins. **Sori** small, placed at very margin of lobes; indusia cup-shaped, up to 1 by 0.6 mm, variable in size and form. **Fig. 6.110**

Thailand.- NORTH-EASTERN: Loei (Phu Kradueng); CENTRAL: Nakhon Nayok (Wang Chao); EAST: Nakhon Ratchasima (Khao Lotueng); SOUTH-EASTERN: Chon Buri (Si Racha, Nong Kho), Trat (Ko Chang); SOUTH-WESTERN: Kanchanaburi (Sai Yok, Thung Kang Yang Hill, Tha Poh), Prachuap Khiri Khan (Bang Saphan); PENINSULAR: Surat Thani (Ban Don, Khao Lak, Kanchanadit), Nakhon Si Thammarat (Khao Luang), Ranong (Khao Phra Mi), Phangnga (Takua Thung), Trang (Khao Chong), Satun, Yala (Bannang Sata).

Distribution.- Widely distributed in the tropic of the Old World (type from Java), Madagasgar to Polynasia and Australia, north to Laos, Hainan and Kwang Tung.

Ecology.- On tree-trunks or on dry rocks in half-shaded places in Mixed deciduous forest or in Dry evergreen forest at 140-180 m altitudes.

Vernacular.- Nakkharat (นาคราช) (Central, Peninsular).

Specimens examined.- BCU: Y. Yuyen 16, 102, 111, 120; T. Boonkerd 1179.

2. <u>Davallia</u> <u>solida</u> (G. Forst.) Sw., Schrad. Bot. 1800(2): 87. 1801; Holttum, Rev. Fl. Malaya 2: 360. f. 207. 1955; Tagawa & K. Iwats., Fl. Thailand 3(2): 163. 1985.- *Trichomanes solidum* Forst., Prod.: 86. 1786.

Rhizome long-creeping, about 6-12 mm in diam., scaly throughout, scales oblong-subtriangular, gradually narrowing towards apex, up to 4 by 2 mm, apical part thin, pale brown, with dense hairs about 1 mm long, caducous, basal portion dark brown to nearly black, imbricate; old portion of rhizome covered by the basal portion of scales up to 3 mm in length. **Stipes** stramineous or some time brown, about 15-30

cm long, distinct grooved on the upper surface, glabrous. **Lamina** tripinnate, subdeltoid, about 30-35 cm long and wide; lateral pinnae subopposite, basal pinnae the largest, oblong-subtriangular, with distinct stalk, pinnules stalked, oblong, cuneate at base, gradually narrowing towards acuminate apex; secondary pinnules (ultimate segment) narrowly oblong, sessile, narrowly cuneate at base, moderate acute at apex; axes distinctly grooved, grooved deccurent to each other; texture subcoriaceous, green; veins visible, but not raised. **Sori** terminal on veinlets, at margin of ultimate segments; involucre cup-shaped, up to 1.5 mm long, about twice as long as wide. **Fig. 6.111**

Thailand.- SOUTH-EASTERN: Chanthaburi (Pong Nam Ron, Makham, Khao Sabap), Trat (Ban Saphan Hin, Ko Chang); PENINSULAR: Surat Thani (Ko Tao, Khun Thale, Bandon), Nakhon Si Thammarat (Tha Samet), Ranong (Khao Phra Mi), Phuket (Ban Krayae, Ko Kut), Trang (Khao Chong), Yala (Betong).

Distribution.- Widely known in Malesia and Polynesia, north to Indochina and S. China.

Ecology.- On tree-trunks or on rocks in half-shaded places in Mixed deciduous forest or in Dry evergreen forest at altitudes at 300 m altitudes.

Vernacular.- Phaya nakkharat (พญานาคราช) (Northern); Wan nakkharat (ว่านนาคราช) (Central); Neraphusi (เนระพูสี) (North-Eastern).

Specimens examined.- BCU: Y. Yuyen 117, 162; T. Boonkerd 332, 566, 1138; BKF: K. Larsen et al. 41060.

2. HUMATA

Cav., Descr. Pl.: 272. 1802.

Rhizome long-creeping, densely scaly with peltate scales, bearing stipes remotely. **Stipes** articulated to rhizome. **Lamina** simple to tripinnatifid. **Sori** round, terminal on veinlets; indusia attached only base or rarely by lateral side a little above the base as well.

Humata repens (L. f.) J. Small ex Diels, in Pflanzenfam. 1(4): 209. 1899; Holttum, Rev. Fl. Malaya 2: 371. f. 216. 1955; Devol & Yang., Fl. Taiwan vol. 1. 2nd ed.: 276. 1980; Tagawa & K. Iwats., Fl. Thailand 3(2): 166. 1985.- *Adiantum repens* L. f.,

Suppl.: 446. 1781.- *Davallia repens* (L. f.) Kuhn., Fil. Deck.: 27. 1867.- *Humata pinnatifida* Bedd., Handb. Suppl.: 1892.

Rhizome slender, about 1.5-2 mm diam, long creeping, densely scaly throughout, scales acuminate at basal edge, long acuminate at apex, up to 5 by 1 mm, brown. **Stipes** stramineous, terete, slender, grooved, scaly when young, about 4-5 cm long. **Lamina** pinnatifid to pinnate, oblong-subdeltoid or roundly pentagonous, up to 2.5-10 by 2-7 cm; basal pinna the largest, oblong-subdeltoid; lobed almost to the midrib or the basal lobes rarely free as separate pinnae; lobed slightly falcate, tapering slightly from base towards the round apex, sessile or adnate; secondary lobes entire and rounded in sterile fronds, in fertile ones with a tooth flanking each sorus; texture coriaceous; veins distinct on lower surface, in a pinnate group corresponding to each secondary lobe. **Sori** marginal, small; indusia nearly semi-circular, entire and free to 1 mm broad. **Fig. 6.112**

Thailand.- NORTHERN: Mae Hong Son (Doi Pha Dam), Chiang Rai (Doi Tung), Chiang Mai (Doi Chiang Dao, Doi Suthep, Doi Inthanon), Lampang, Lamphun (Doi Khun Tan), Phitsanulok (Phu Miang); NORTH-EASTERN: Loei (Phu Luang, Phu Kradueng); CENTRAL: Nakhon Nayok (Khao Yai); SOUTH-EASTERN; Chanthaburi (Khao Sabap), Trat (Ko Chang, Khao Kuap); SOUTH-WESTERN: Prachuap Khiri Khan (Khao Luang); PENINSULAR: Surat Thani (Khao Nom Sao), Nakhon Si Thammarat (Khao Luang, Khiriwong), Phangnga (Takua Pa, Khao Phra Mi), Trang (Khao Chong), Yala (Gunong Ina, Khao Kala Khiri).

Distribution.- Widely distributed in the tropic of the Old World, Madagasgar and Seychelles, Mascarene Islands, Himalayas to S. Japan (type), SE. Asia generally through Malesia to Polynesia and Australia.

Ecology.- On mossy tree-trunks or on rather dry rocks in half-shaded places in Tropical evergreen forest or in Hill evergreen forest at 960-1050 m altitudes.

Vernacular.- Kut hom bai yoi (กูดห้อมใบย่อย) (Northern): Kut thong (กูดทอง) (North-eastern); Nakkharat tua mia (นาคราชตัวเมีย) (South-eastern).

Specimens examined.- BCU: Y. Yuyen 77, 146; P. Rachata 184; T. Boonkerd 131, 467, 1407.

3. LEUCOSTEGIA

C. Presl, Tent. Pterid.: 94. 1836.

Rhizome creeping, bearing both hairs and scales. **Stipes** articulate to rhizome. **Lamina** pinnately decompound, ultimate segment not narrow. **Sori** round, large, with large indusia; indusia fixed at base or at base and side, reaching or surpassing the margin of segments.

Leucostegia immersa C. Presl, Tent. Pterid.: 95. t. 4. f. 11. 1836; Bedd., Handb.: 51. 1969; Devol & Yang., Fl. Taiwan vol. 1. 2nd ed.: 279. pl. 98. 1980; Holttum, Rev. Fl. Malaya 2: 352. 1955; Tagawa & K. Iwats., Fl. Thailand 3(2): 169. f. 12. 5. 1985.- *Davallia immersa* Wall. ex Hook., Sp. Fil. 1: 156. 1846.

Rhizome 5 mm thick without scale, wide-creeping, bearing fronds remotely; hairs rather dense, golden-yellow, multicellular, wooly. **Stipes** stramineous or brownish on lower surface, scaly at base, scale narrowly lanceolate, 2 by 0.5 mm, light brown, Mémbranous, entire at margin, grabrescent upwards, up to 25 cm or more long, grooved on the upper surface. **Lamina** quadripinnatifid, oblong-subdeltoid, acuminate at apex, up to 30 by 20 cm; pinnae more than 10 pairs, the lowest the largest, with distinct petioles, lower one asymmetrically oblong-subdeltoid; acuminate at apex, broadly at base, up to 12 cm long and 9 cm wide; pinnules oblong to subdeltoid on stalked in larger ones; secondary pinnules oblong to narrower, with 1-6 segments, ultimate segment circular to oblong or terminal ones spathulate coarsely dentate at margin; texture thin herbaceous, light green, glabrous. **Sori** terminal on veinlets on to each segment; indusia circular, attached only by base, entire, 1.3-2 mm broad, with to pale brown, glabrous. **Fig. 6.113, 6.114**

Thailand.- NORTHERN: Chiang Rai (Doi Tung), Chiang Mai (Doi Phahom Pok, Doi Chiang Dao, Pong Pa Po, Doi Suthep, Doi Inthanon, Sop Aep); NORTH-EASTERN: Loei (Phu Luang, Phu Kradueng); SOUTH-WESTERN: Kanchanaburi (Bo Rae); PENINSULAR: Surat Thani (Ban Don).

Distribution.- S. India, E. Himalayas (type), SW. China, Myanmar, Indochina, W. Malesia to Phillipines, north to Taiwan.

Ecology.- Terrestrial fern on moutain-slopes or in muddy crevices of rock in Hill evergreen forest at 1050 m altitudes.

Vernacular.- Kut mak (กูดหมัก) (Northern).

Specimens examined.- BCU: Y. Yuyen 152; P. Rachata 310, 311; T. Boonkerd 497, 1235; BKF: J. F. Maxwell 93-950; Tagawa et al. T1283.

OLEANDRACEAE

Devol and Kuo., Fl. Taiwan vol. 1. 2nd ed.: 318. 1980

Terrestrial or lithophytes. **Rhizome** slender. **Lamina** simple or pinnate; pinnae articulate to rachis, often caducous; veins free, once or twice forked. **Sori** round or submarginal, born at the end of veinlets; indusia reniform.

Key to the genera

1. Sori terminal on anterior branches of veins; fronds pinnate; stipes not articulated **1. Nephrolepis**
1. Sori dorsal on veins; fronds simple; stipes articulated **2. Oleandra**

1. NEPHROLEPIS

Schott, Gen. Fil. ad t. 3. 1834.

Rhizome short, erect or suberect, scaly; scales peltate, bicoloured with pale edge. **Lamina** 1-pinnate; pinnae sessile, articulate to rachis; veins all free. Sori terminal on anterior branches of vein-group, one for each crena, arranged in one row, or continuous along margin; indusia round to reniform.

Key to the species

1. Pinnae without auricle or slightly auricled at base, about 2.5 cm wide; sori medial **1. N. biserata**
1. Pinnae distinct with auricle at anterior base, about 1.3 cm wide; sori submarginal **2. N. hirsutula**

1. Nephrolepis biserrata (Sw.) Schott, Gen. Fil. ad. t. 3. 1834; Holttum, Rev. Fl. Malaya 2: 380. f. 217. 1955; Devol and Kuo, Fl. Taiwan vol 1. 2 nd ed. 322. 1980; Tagawa & K. Iwats., Fl. Thailand 3(2): 175. 1985.- *Aspidium biserratum* Sw., Schrad. J. Bot. 1800 (2): 32. 1801.- *Aspidium acutum* Schkuhr, Kr. Gew. 1: 32. t. 31. 1806.- *Nephrolepis acuta* (Schkuhr) C. Presl, Tent. Pterid.: 79. 1836; Bedd., Handb.: 284. 1969.

Rhizome ascending or suberect, bearing a cluster fo fronds, numerous wiry roots; scales gradually narrowing from base towards tailed apex, up to 7 by 1 mm broad, edge bearing numerous fine hairs, dark brown with pale brown edges. **Stipes** up to 60 cm long, shining olive-brown. covered with dense narrow scales; rachis similarly to stipe, but with small scales in the groove. **Lamina** 1-pinnate, large, about 190 by 30 cm, lanceolate, narrowing towards both apex and base, lateral pinnae articulate to rachis, numerous; middle ones about 2.5-3 cm apart, larger, patent or slightly falcate at posterior end, linear-lanceolate, acuminate to caudate at apex, cuneate at base, sessile; sterile pinnae wider than fertile, about 2.5 cm wide, the basal ones subequal and truncate at the base, margin crenate; fertile pinnae commonly 1.5-2 cm wide near the base, 15 cm long, base as in sterile pinnae or unequally cuneate, sometime slightly auricled on the acroscopic side; texture subchartaceous, veins forked near costa, posterior branches sometimes forked again at middle part, minutely scaly on costa and even on lamina surface. **Sori** round, in one row at 1/3 way from margin to costa; indusia reniform-round, about 1 mm diam. **Fig. 6.115**

Thailand.- NORTHERN: Chiang Rai, Chiang Mai (Doi Suthep, Ban Du); CENTRAL: Bangkok; SOUTH-EASTERN: Chonburi (Si Racha), Trat (Ko Chang, Ban Saphanhin, Khlong Yai); PENINSULAR: Surat Thani (Khao Tao) Nakhon Si Thammarat (Khao Luang), Song Khla (Rattaphum), Narathiwat (Waeng), Phangnga (Ta Kua Tung), Trang (Khao Chong), Satun, Yala (Bannang Sata).

Distribution.- Pantropic (Type from America).

Ecology.- Usually occurs along stream or on rather dry mountain slope in Mixed deciduous forest or in Dry evergreen forest at 100-400 m altitudes.

Specimens examined.- BCU: Y. Yuyen 108; T. Boonkerd 337, 1424, 1546.

2. <u>Nephrolepis</u> <u>hirsutula</u> (G. Forst.) C. Presl, Tent. Pterid.: 79. 1836; Holttum, Rev. Fl. Malaya 2: 382. f. 222. 1955; Devol and Kuo, Fl. Taiwan vol 1. 2 nd ed. 322. 1980; Tagawa & K. Iwats., Fl. Thailand 3(2): 177. 1985.- *Polypodium hirsutulum* Forst., Prod.: 81. 1786.- *Nephrolepis exaltata* auct. non (L.) Schoott: Bedd., Handb.: 282. 1969.- *Nephrolepis acutifolia* auct. non (Desv.) H. Christ: H. Christ, Bot. Tidsskr. 24: 110. 1901.

Rhizome short, erect, bearing a tuft of fronds, a few wiry roots, and stolon; scales dense, appressed, gradually narrowing from round base to acute apex, bicolour

with dark brown central portion and ferruginous edge, about 3 by 1 mm, hairy at margin. **Stipes** to 27 cm long, densely covered with small pale scales with hairy edge throughout. **Lamina** 1-pinnate, up to 50-90 cm long, and to about 8-15 cm wide, gradually narrowing towards both ends, lateral pinnate about 65 pairs, very close, usually widened base, overlapping; lowest pinnae more widely spaced; the middle ones larger, gradually narrowing from base towards acute apex, distinctly auricular at anterior and round to slightly auricular at posterior base; sterile pinnae up to 8 by 1.5 cm, shallowly crenate at margin; fertile pinnae narrower than sterile, to about 1.3 cm wide; texture chartaceous, very minutely scaly on costa, veins hardly visible in living plant, slightly raised on dried specimen. **Sori** submarginal; indusia reniform, up to 1 mm diam. **Fig. 6.116**

Thailand.- NORTHERN: Chiang Mai (Fang); NORT-EASTERN: Nong Khai; PENINSULAR: Chumphon (Ko Wiang), Nakhon Si Thammarat (Khao luang, Khiriwong), Ranong (Khao Phota Chongdong), Krabi (Khao Sato), Satun, Yala (Ban Nang Sata).

Distribution.- Tropical Asia to the Pacific.

Ecology.- Terrestrails fern along stream in light shade in Mixed deciduous forest or in Dry evergreen forest at 150-400 m altitudes.

Specimens examined.- BCU: Y. Yuyen 1; T. Boonkerd 1126.

2. OLEANDRA

Cav. Ann. Hist Nat. 1: 115. 1799.

Rhizome long-creeping, covered with peltate scales. **Stipes** with distinct articulation. **Lamina** simple, linear-lanceolate; veins all free. **Sori** dorsal on anterior branches of veins, close to midrib; indusia reniform.

Oleandra musifolia (Blume) C. Presl, Epim.: 42. 1849; Bedd., Handb.: 287. 1969; Tagawa & K. Iwats., Fl. Thailand 3(2): 181. 1985.- *Aspidium musifolium* Bl., En. Pl. Jav.: 141. 1828.

Rhizome long-creeping, up to 5 mm diam., bearing remote fronds, densely scaly throughout; scales appressed, lanceolate, round to moderately acute at basal edge, gradually narrowing to apex, about 7 by 1 mm, brown with dark attached point at base, paler and hairy at margin of apical portion. **Stipes** short, up to 3-4 cm including

low phyllopode, about 5-10 mm tall, bearing both scales and hairs. **Lamina** simple, linear-lanceolate, caudately acuminate at apex, gradually narrowing towards narrow and cuneate base, up to 40 by 3 cm, margin entire; midrib raised below, grooved above, scaly and hairy on both surface, scale peltate, hairy at margin, lanceolate, pale brown scales up to 2 mm long 0.5 mm broad; texture subcoriaceous, light green; vein once or twice forked near midrib, all free, ending just inside narrow cartilaginous margin. **Sori** irregular row near midrib; indusia up to 1 mm in breadth, glabrous. **Fig. 6.117**

Thailand.- NORTHERN: Chiang Mai (Doi Chiang Dao, Doi Inthanon), Lamphun (Doi Khun Tan), Phare (Mae Sai), Phetchabun (Phu Miang), Tak (Ban Musoe); NORTH-EASTERN: Loei (Phu Luang, Phu Kradueng); CENTRAL: Nakhon Nayok (Khao Yai); SOUTH-WESTERN: Kanchanaburi (Khriti); PENINSULAR: Ranong (Khao Phota Chongdong), Phangnga (Khao Phra Mi)

Distribution.- Ceylon, Indochina to Malesia (type from Java).

Ecology.- On tree-trunk or rocks in sunny places or light shade in Hill evergreen forest 1050 m altitudes.

Vernacular.- Thao nakharat (เถานาคราช) (North-eastern).

Specimens examined.- BCU: Y. Yuyen 87, 148; T. Boonkerd 1241, 1244, 1259.

ORDER POLYPODIALES

POLYPODIACEAE

Holttum, Rev. Fl. Malaya 2: 129. 1955.

Rhizome creeping, usually epiphytic, externally scaly; scales almost always peltate at base. **Frond** arranged in two ranks on upper side of the rhizome. **Stipes** usually articulate to rhizome, simple and entire or more or less deeply lobed or pinnate; veins anastomosing, with free veinlets in areoles. **Sori** without indusium, round, sometime sunk in cavitiess, elongate parallel lateral mainveins, along the margin or acrostichoid on some parts of the fronds.

Key to the genera

1. Nest leaves present
   2. Fertile frond simple, dichotomous, pendulous; stellate hairs present **12. Platycerium**
   2. Fertile frond pinnate or pinnately lobed, erect; stellate hairs absent **5. Drynaria**
1. Nest leaves lacking
   3. Fronds simple
      4. Fronds covered with stellate hairs **14. Pyrrosia**
      4. Fronds not having stellate hairs
         5. Fronds bearing peltate scales on surface or in sori
            6. Sori round or elongate along margin of fronds
               7. Rhizome scales glabrous
                  8. Frond dimorphic; sori round or continuous along margin **6. Lemmaphyllum**
                  8. Frond monomorphic; sori round, sunk in cavities **7. Lepisorus**
               7. Rhizome scales bearing a few long hairs at base **11. Neocheiropteris**
            6. Sporangia acrostichoid, covered elongate tip of frond **2. Belvisia**
         5. Fronds not bearing any peltate scales
            9. Fronds dimorphic; sporangia acrostichoid
               10. Sori covering the whole under surface of linear fertile lamina **8. Leptochilus**
               10. Sori linear, usually continuous, one between the adjacent lateral main veins, oblique to costa **3. Colysis**
            9. Fronds monomorphic
               11. Sori round or nearly so; at least the middle part of scales clathrate **10. Microsorum**
               11. Sori forming continuous line oblique to midribs of fronds; scales clathrate **9. Loxogramme**
   3. Fronds pinnate or pinnately lobed
      15. Fronds medium, stipitate, basal portion normal
         16. Sori on reticulate veins; pinnae jointed to rachis
            17. Scales not clathrate **4. Crypsinus**
            17. At least the middle part of scales clathrate **10. Microsorum**
         16. Sori terminal on distinct free veins, pinnae jointed to rachis **13. Polypodium**
      15. Fronds large, sessile, basal portion like nest-leaves **1. Aglaomorpha**

1. AGLAOMORPHA

Schott, Gen. Fil.: ad pl. 20. 1834.

Rhizome long-creeping, thick, scaly. **Lamina** in one form, partialy dimorphic; upper part like foliage leaves, pinnatifid, lower part like nest-leaves, very broad at base. **Sori** small, round or varioudly spreading and united.

Aglaomorpha coronans (Wall. ex Mett.) Copel., Univ. Calif Publ. Bot. 16: 117. 1929; Tagawa & K. Iwats., Fl. Thailand 3(4): 551. f. 55. 4-5. 1989.- *Polypodium coronans* Wall. ex Mett., Abh. Senck. Naturf. Ges. 2: 121. t. 3. f. 40-41. 1857.- *Drynaria coronans* (Wall. ex Mett.) J. Sm., J. Bot. 4: 61. 1841; Bedd., Handb.: 338. 1969.- *Pseudodrynaria coronans* (Wall. ex Mett.) Ching, Sunyatsenia 5: 262. 1940.- *Polypodium conjugatum* Bak., Syn. Fil.: 366. 1868.- *Drynaria conjugata* (Bak.) Bedd., Fern Brit. India correct. 1870.- *Aglaomorpha heraclea* (Kunze) Copel. sensu Holttum, Dansk Bot. Ark. 20: 21. 1961

Rhizome creeping, thick, about 1.5 mm diam., densely scaly throughout; scales brown, linear, about 7 by 0.5 mm, sharply toothed at margin. **Lamina** simple-pinnatifid, sessile, up to 120 by 44 cm; deeply lobed closed to rachis; costa wing less than 1 cm broad; base broadly round to cordate, up to 15 cm broad, subentire or shallowly lobed, brown, like nest leaves of *Drynaria*; lobes of upper part of fronds ascending, about 18 pairs, linear-subtriangular, attenuately acuminate at apex, entire to subentire at margin, up to 25 by 3 cm, lobes articulated to rachis; rachis raised on lower surface, grooved above, sparsely brown hairs covering throughout on rachis and costa; veins raised on both surface, venation drynaroids, or with complicately reticulate, main areoles quadrangular, smaller areoles with free included veinlets; texture coriaceous, green, glabrous. **Sori** one row between main veins, slightly elongated, or sometimes uniting longitudinally, but rarely continuous beyonds cross veins. **Fig. 6.122**

Thailand.- NORTHERN: Chiang Rai (Doi Tung), Chiang Mai (Doi Hua Mot, Doi Suthep, Huai Tong, Doi Inthanon), Lampang (Mae Tia), Phrae (Mae Sai), Tak (Huai Krasa, Doi Musoe), Phitsanulok (Thung Salaeng Luang); EASTERN: Chaiyaphum (Thung Kamang, Nam Phrom); NORTH-EASTERN: Loei (Phu Luang, Phu Kradueng), Prachin Buri (Khao Yai); SOUTH-EASTERN: Chanthaburi (Khao Soi Dao); SOUTH-WESTERN: Kanchanaburi (Song Tho); PENINSULAR: Surat Thani (Ban Don), Nakhon Si Thammarat (Khao Luang), Trang (Khao Chong), Phangnga (Khao Phota Luang Kaeo).

Distribution.- Himalayas to S. China, Indochina, Taiwan and northwards to the Ryukyus; Khao Chong in Trang province is the southernmost record of this species.

Ecology.- On rather dry or mossy rocks or on tree-trunks or rarely terrestrial in light shade in Tropical evergreen forest to Hill evergreen forest at 940-1050 m altitudes.

Vernacular.- Bai kut om (ใบกูดอ้อม) (Northern).

Specimens examined.- BCU: Y. Yuyen 54; P. Rachata 89; T. Boonkerd 587, 615; T. Seelanan 22.

2. BELVISIA

Mirb., Hist. Nat. Veg. 5: 111. 1803.- *Hymenolepis* Kaulf., Enum.: 146. 1824.

Rhizome short-creeping. **Lamina** simple, jointed to rhizome, with short indistinct stipes; veins copiously anastomosing; fertile portion on narrow apical part of fronds, usually covered throughout with sporangia on lower surface. **Sporangia** mixed with stalked peltate paraphyses and protected also by the narrow reflexed edge of lamina.

Key to the species

1. Rhizome-scales concolorous, clathrate, toothed at margin; lamina about 2 cm wide **1. B. mucronata**
1. Rhizome-scales bicolored, with dark central portion and pale ferrugineous marginal portion without prominent teeth; lamina about 1 cm wide **2. B. revoluta**

1. Belvisia mucronata (Fée) Copel., Gen. Fil.: 192. 1947; Holttum, Rev. Fl. Malaya 2: 155. 1955; Devol and Kuo, Fl. Taiwan vol 1. 2 nd ed. 168. pl. 57. 1980; Tagawa & K. Iwats., Fl. Thailand 3(4): 520. f. 52. 4-6. 1989.- *Hymenolepis mucronata* Fée, Gen. Fil.: 82. pl. 68. f. 1. 1852.

Rhizome creeping, about 3 mm diam., bearing fronds rather closely, scaly at apex; scales oblong-ovate, acuminate at apex, rounded at base, broadest at basal portion, brown to dark, clathrate, cells all large and thick-walled, edges shortly toothed. **Stipes** up to 1-3 cm long, narrowly winged on upper portion, castaneous to dark, scaly at base. **Lamina** simple, linear-lanceolate, gradually narrowing towards both ends, attenuate at both apex and base, entire or little revolute at margin, up to 20 by 2 cm; texture subcoriaceous, deep green, pale in lower surface; midrib raised on

both surface, stramineous to green, vein hardly visible; fertile portion of fronds at apex, usually constricted at junction with sterile portion, linear, up to 5 by 0.2 cm, wholely covered by sporangia except the margin enrolled to protect young sori. **Fig. 6.121**

Thailand.- SOUTH-EASTERN: Chanthaburi (Takhamao Falls); PENINSULAR: Nakhon Si Thammarat (Khiriwong, Khao Luang), Yala (Betong).

Distribution.- Tropics of Asia (type from Malay Island), from Sri Lanka to Polynesia, north to Vietnam.

Ecology.- On tree-trunks in Tropical evergreen forest at 800 m altitudes.

Specimens examined.- BCU: Y. Yuyen 174; P. Rachata 273; T. Boonkerd 320, 1128.

2. Belvisia revoluta (Blume) Copel., Gen. Fil.: 192. 1947; Holttum, Rev. Fl. Malaya 2: 155. f. 67. 1955; Tagawa & K. Iwats., Fl. Thailand 3(4): 521. 1989.- *Hymenopsis revoluta* Bl., En. Pl. Jav.: 201. 1828.- *Gymnopteris spicata* (L. f.) C. Presl, Tent. 244. t. 11, f. 7. 1836; Bedd., Handb.: 432. f. 261. 1969.

Rhizome short-creeping, about 3-5 mm diam., bearing many fronds closely, densely scaly; scales oblong-ovate, gradually narrowing from base towards apex, round at base, attenuate at apex, entire, about 3 by 1 mm, the central portion dark brown with thick internal walls, edges thin, pale brown, of much smaller cells. **Stipes** up to 3 cm long, not distinct from midrib of fronds, narrowly winged on the upper portion, stramineous to brown, scaly at base. **Lamina** simple, linear-lanceolate, usually broadest at middle portion, attenuate towards both ends, 6-16 cm long in sterile portion, 0.5-1 cm broad, margin more or less revolute; midrib raised below, grooved above, stramineous to brown; texture softly chartaceous, sparsely like-hair brown scales throughout on upper surface and paler below; veins hardly visible; fertile portion linear, with distinct constriction at base, up to 2-5 by 0.2 cm broad, covered wholely with sporangia except on midribs and margin. **Fig. 6.119, 6.120**

Thailand.- NORTHERN: Tak (Mae Sot, Ban Musoe); NORTH-EASTERN: Loei (Phu Luang, Phu Kradueng); EASTERN: Nakhon Ratchasima; PENINSULAR: Nakhon Si Thammarat (Khao Luang), Trang (Khao Chong).

Distribution.- Tropics of Asia (type from Java), from Sri Lanka to Tahiti.

Ecology.- On tree-trunks in Hill evergreen forest at 1100 m altitudes.

Specimens examined.- BCU: Y. Yuyen 45; T. Boonkerd 1316, 1406.

3. COLYSIS

C. Presl, Tent. Pterid.: 214. pl. 9. f. 8. 1836.

Rhizome creeping, scaly. **Lamina** with distinct stipes, simple to pinnate, rarely dimorphic, articulated to rhizome; vein anastomosing to form irregularly arranged areoles with included veinlets. **Sori** linear, usually continuous, one between adjacent lateral main veins, oblique to costae, naked.

Colysis pedunculata (Hook. & Grev.) Ching, Bull. Fan Men. Inst. Biol. 4: 321. 1933; Holttum, Rev. Fl. Malaya 2: 160. f. 71. 1955; Tagawa & K. Iwats., Fl. Thailand 3(4): 538. 1989.- *Ceterach pedunculata* Hook. & Grev., Ic. Fil.: t. 5. 1827.- *Gymnogramma hamiltoniana* Wall. ex Hook., sp. Fil. 5. 161. 1864.- *Selliguea hamiltoniana* (Hook.) Bedd., Ferns Br. Ind.: t. 239. 1867; Handb.: 390. f. 226. 1969.

Rhizome long-creeping, stramineous, bearing fronds about 1-3 cm apart, scaly; scales narrowly subtriangular, gradually narrowing from base towards long acuminate apex, about 3 by 0.5 mm, dark greyish-brown, clathrate, margin entire. **Fronds** simple, subdimorphic. **Sterile fronds:** stipes about 10 cm long, narrowly winged nearly to the base; laminae oblong, usually gradually narrowing towards acute to acuminate apex, cuneate at base, edges entire, up to 15-25 cm long and 3 cm wide; main lateral veins distinct, up to 8 mm apart, veins forming areoles with included veinlets; texture softly papyraceous, pale green in dry specimen, glabrous. **Fertile fronds:** stipes up to 27 cm long, stramineous, wingless, glabrous; laminae oblong, broadest at middle portion, cuneate at base, up to 15 by 1.5 cm. **Sori** up to 2 mm broad, elongate between adjacent main veins. **Fig. 6.118** .

Thailand.- NORTHERN: Chiang Mai (Doi Chiang Dao); SOUTH-EASTERN: Chon Buri (Si Racha), Chanthaburi (Khao Soi Dao); PENINSULAR: Surat Thani (Ko Samui, Ban Don), Krabi (Khao Phanom Bencha), Nakhon Si Thamarat (Chawang), Trang (Khao Chong, Ko Talibong).

Distribution.- SE. Himalayas (type), SW. China (Yunnan), Vietnam to Malaysia.

Ecology.- Climbing on tree trunks in Hill evergreen forest at 1050 m altitudes.

Vernacular.- Kra prok nom maeu (กระปรอกนมแมว) (South-easthern).

Specimens examined.- BCU: Y. Yuyen 184; T. Boonkerd 141; BKF: Iwatsuki & N. Kufuoka 7157; Smitinand 476, 934A.

4. CRYPSINUS

C. Presl, Epim. Bot.: 123. 1849.

Epiphytic plants. **Rhizome** long-creeping, scaly. **Stipes** jointed to rhizome. **Lamina** simple, lobed or rarely pinnate; veins anastomosing, areoles irregular, with included free veinlets. **Sori** round, one between adjacent main veins, in a single row at each side of costa, or scattered on the under surface of fronds, sometime sunk in deep cavities.

Crypsinus oxylobus (Wall. ex Kunze) Sledge, Bull. Brit. Mus. (Nat. Hist.) Bot. 2: 145. 1960; Tagawa & K. Iwats., Fl. Thailand 3(4): 559. f. 56. 6. 1989.- *Polypodium oxylobum* Wall. ex Kunze, Linnaea 24: 255. 1851.- *Phymatodes oxyloba* (Wall. ex Kunze) C. Presl ex Ching, Contr. Inst. Bot. Nat. Acad. Peiping 2: 67. 1933.- *Pleopeltis hastata* (Thunb.) Bedd., Handb.: 362. f. 205. 1883.- *Pleopeltis trifida* (D. Don) Bedd., Handb. Suppl.: 96. 1892.- *Crypsinus taenitus* var. *palmatus* (Bl.) C. Chr. sensu Holttum, Dansk Bot. Ark. 23. 231. 1965.

Rhizome long-creeping, about 3 mm diam., densely scaly throughout; scales gradually narrowing from round peltate base to long-tailed apex, about 3 by 1 mm, dark brown in central basal portion, paler in narrow tail, minutely toothed at margin. **Stipe** brown to castaneous jointed to rhizome, glabrous upwards, up to 6-15 cm long. **Lamina** simple, lobed, with 1-3 pairs of lateral lobes and terminal one, up to 14-16 by 17-20 cm; triangular in outline truncate at base, acute at apex; rachis brown to castaneous beneath, paler on upper surface, winged with lobes about 7 mm in breadth; lateral lobes usually longest at base, becoming smaller upwards, ascending, linear to oblong-subdeltoid, caudately acuminate at apex, up to 9-10 by 1.5-2 cm, entire, terminal lobes longer; midrib raised on both surfaces, main veins distinct, ascending, more or less zigzag, the other veins obcure, reticulate, forming irregular areoles with included veinlets distinct in upper surface; texture papyraceous, deep green to paler, paler on lower surface, glabrous. **Sori** one between main veins, in a single row along

both side of midrib, subcostular or medial, round 2 mm diam, raised on lower surface, hardly raised on upper surface. **Fig. 6.123**

Thailand.- NORTHERN: Chiang Rai (Phu Lanka, Doi Tung), Chiang Mai (Pong Pho, Doi Chiang Dao, Doi Suthep, Huai Kaeo, Doi Pha Hom Pok, Doi Hua Mot, Doi Inthanon), Lamphun (Doi Khun Tan), Phitsanulok (Phu Miang); NORTH-EASTERN: Loei (Phu Luang, Phu Kradueng), Prachin Buri (Khao Yai); SOUTH-WESTERN: Ratchaburi (Khao Luang).

Distribution.- N. India (type), Upper Myanmar, SW. China (Yunnan & Szechuwan) and Indochina.

Ecology.- Epiphytes commonly on mossy tree-trunks in Hill evergreen forest at 1050 m altitudes.

Vernacular.- Kut hom (กูดฮ่อม) (Northern).

Specimens examined.- BCU: Y. Yuyen 81, 151; P. Rachata 259, 261, 300, 319; T. Boonkerd 79.

5. DRYNARIA

(Bory) J. Sm., J. Bot. 4: 60. 1841.

Rhizome creeping, scaly. **Dimorphic**; Nest leaves, simple, sessile, persistently covered on rhizome, usually humus collecting; foliage leaves pinnatifid to pinnate; pinnae jointed to rachis; veins anastomosing to form drynarioid venation. **Sori** round or elongate.

Key to the species

1. Foliage-leaves lobed, pinnatifid or pinnatisect
   2. Sori dispersed in a few irregular rows between adjacent main veins; lateral lobed up to 2-3 cm wide **1. D. bonii**

   2. Sori in one or two regular rows between adjacent mainveins; lateral lobed about 6 cm wide **2. D. quercifolia**
1. Foliage-leaves pinnate, up to 30-40 pairs **3. D. rigidula**

1. Drynaria bonii H. Christ, Not. Syst. 1: 186. 1910; Tagawa & K. Iwats., Fl. Thailand 3(4): 545. 1989.

Rhizome creeping, densely scaly, sometime very flat, 1 cm wide, 5 mm thick; scales oval to circular with long tails, peltate, round at base, up to 5 mm long with

tails, 1.5 mm in length, 1 broad, sharply toothed to fimbricate at margin, bicoloured with black brown small central portion and tail, brown margin. **Nest-leaves:** many, imbricate, covering rhizome almost entirely, oval to circular in outline, deeply cordate at base, subentire at margin, up to 2.5-4.5 by 2-4 cm. **Foliage-leaves:** stipes stramineous, up to 10-28 cm long, narrowly winged almost to the base, subglabrous at base; laminae pinnatifid nearly to rachis, oblong-lanceolate in outline, deccurent laminae, less than 5 mm in breadth, to about 38-50 by 18-24 cm; lobes more or less ascending, oblong-lanceolate, acute to cuadately acuminate, 12-15 by 2-3 cm, subentire, more or less narrowed towards base; veins distinct raised on both surface, finely anastomosing; texture chartaceous, light green, glabrous. **Sori** round or punctiform, in 2-5 irregular rows between main veins. **Fig. 6.124**

Thailand.- NORTHERN: Chiang Rai (Doi Tham Yup), Chiang Mai (Doi Suthep, Doi Saket, Mae Klang), Mae Hong Son, Lampang (Ngao, Mae Tha), Phrae (Mae Ban), Tak (Lan Sang, Ban Na), Phitsanulok (Thung Salaeng Luang); NORTH-EASTERN: Loei (Phu Luang, Phu Kradueng), Nong Khai; EASTERN: Chaiyaphum (Tat Ton), Nakhon Ratchasima (Pak Thong Chai); SOUTH-EASTERN: Prachin Buri (Bang Ban Hills, Khao Yai), Chon Buri (Si Racha, Khao Khieo); CENTRAL: Saraburi (Muak Lek), Sing Buri, Uthai Thani (Ban Rai); SOUTH-WESTERN: Kanchanaburi (Khao nam Tok), Prachuap Khiri Khan (Huai Yang).

Distribution.- China (Kweichow) and Indochina (type).

Ecology.- On dry or muddy rocks and tree-trunks in light shade in Mixed deciduous forest at 170 m altitudes.

Specimens examined.- BCU: Y. Yuyen 17; T. Boonkerd 13, 160, 559, 1290.

2. <u>Drynaria</u> <u>quercifolia</u> (L.) J. Sm., J. Bot. 3: 398. 1841; Holttum, Rev. Fl. Malaya 2: 182. f. 88. 1955; Bedd., Handb.: 341. f. 191. 1969; Tagawa & K. Iwats., Fl. Thailand 3 (4): 546. 1989.- *Polypodium quercifolium* L., Sp. Pl. 2: 1087. 1753. Plate III: 4.

Rhizome creeping, thick, about 1.5-2 cm diam., densely scaly; scales very dark-brown, to about 1 cm long by 1 mm broad, gradually narrowing from peltate base to the very narrow apex, edges paler and closely finely toothed. **Nest-leaves:** simple, ovate, up to 17 by 15 cm, shallowly lobed; lobes close, 1-2 by 1.5 cm, rounded to moderate acute at apex, entire. **Foliage-leaves:** stipes about 25-30 cm long, stramineous to brown, very narrowly winged throughout, grooved above, densely scaly

at base with those like rhizome-scales, laminae deeply pinnatifid, oblong, up to 80 by 60 cm; continuous to the next ones by rather broad wings about 1 cm in breadth; lobes to 34 by 6 cm, ascending, gradually narrowing from base to acute or acuminate, seperated by rather narrow sinuses, entire and more or less crisped at margin; veins distinct raised on both surface, finely anastomosing; texture coriaceous, shining pale green, glabrous. **Sori** round or oblong, two row between adjacent main veins. **Fig. 6.125**

Thailand.- NORTHERN: Chiang Rai, Chiang Mai (Doi Saket), Phitsanulok (Thung Salaeng Luang), Tak; NORTH-EASTERN: Nong Khai; SOUTH-EASTERN: Chanthaburi (Khao Sabap, Makham), Chon Buri (Si Racha, Ko Sichang), Trat (Ban Saphan Hin); SOUTH-WESTERN: Khanchanaburi (Sai Yok, Wangka, Thung Kang Yang), Prachuap Khiri Khan (Huai Yang, Bang Saphan); PENINSULAR: Phangnga (Takua Thung), Krabi, Surat Thani (Ko Tao, Ban Don), Nakhon Si Thammarat (Khao Luang), Phuket (Ban Ma Phrao), Phattalung (Ko Si Ko Ha), Trang, Satun, Yala (Bannang Sata).

Distribution.- Sri Lanka, India to S. China and Indochina, Malesia throughout to Fiji and tropical Australia.

Ecology.- On rather dry rocks on hillside in light shade in Mixed deciduous forest or Dry evergreen forest at 170 m altitudes.

Vernacular. Kratae tai mai (กระแตไต่ไม้) (Central); Kut kha hok (กูดขาฮอก), Chao-wa-na (เข้าวะนะ), Phu-dong-khae (พุดองแกะ) (Karen/Nortern); Dao-ka-lo (เดากาโละ) (Malay/Peninsular); Bai hu chang (ใบหูช้าง), Sa bai nang (สะไบนาง), Hua wao (หัวว่าว) (South-western); Sa-mong (สะโมง) (Suai, Surin).

Specimens examined.- BCU: Y. Yuyen 25; T. Boonkerd 183, 184, 1281.

3. <u>Drynaria</u> <u>rigidula</u> (Sw.) Bedd., Ferns Brit. India. 314. 1869; Holttum, Rev. Fl. Malaya 2: 183. f. 90. 1955; Bedd., Handb.: 344. f. 192. 1969; Tagawa & K. Iwats., Fl. Thailand 3(4): 550. 1989.- *Polypodium rigidula* Sw., Schrad. J. Bot. 1800 (2): 26. 1801. Plate IV: 5.

Rhizome creeping, about 0.6-1 cm diam., densely scaly throughout; scales gradually narrowing from peltate rounded base to apex, red-brown with dark basal

point, up to 5 by 1 mm, sparsely hairy at margin with pale long downy hairs. **Nest-leaves:** simple, narrowly oblong-subdeltoid, round at base, up to 15 by 5 cm, lobed to 1/3 way towards midrib; lobed subtriangular, acute at apex, entire, up to 1 by 1 cm. **Foliage-leaves:** pinnate, stipes pale castaneous to brown, more or less downy hairy, up to 18 cm long, but usually short, often bearing undeveloped pinnae at base of stipes, lamina oblong-lanceolate, up to 100 by 30 cm; rachis pale brown to pale purple, downy hairy; pinnae jointed to the rachis, about 30-40 pairs, linear-lanceolate, up to 8-18 by 1-1.5 cm, sessile, subentire in sterile or serrate at margin in fertile ones, caudately acuminate at apex, unequally cuneate at base; costa pale stramineous; veins raised on both surface, anastomosing, **Sori** round, closed to costa, one row along each side of costa, one between main veins, raised on upper surface. **Fig. 6.126**

Thailand.- NORTHERN: Chiang Rai (Mae Kok), Chiang Mai (Mae Ho, Kong Kat, Ping Khong, Doi Suthep, Sop Aep, Doi Inthanon, Bo luang), Phitsanulok (Thung Salaeng Luang), Tak; NORTH-EASTERN: Loei (Phu Luang, Phu Kradueng); CENTRAL: Nakhon Nayok (Khao Yai); SOUTH-EASTERN: Chanthaburi (Khao Sabap); SOUTH-WESTERN: Kanchanaburi (Wangka, Thung Kang Yang); PENINSULAR: Krabi (Ao Luek), Surat Thani (Ban Don), Yala (Betong).

Distribution.- Indochina, Malesia, Polynesia and tropical Australia also in Myanmar.

Ecology.- On tree trunk, or in muddy crevices of cliffs in Mixed deciduous forest or Dry evergreen forest at 280-400 m altitudes.

Specimens examined.- BCU: Y. Yuyen 65, 104, 114; K, Sridith 18; T. Boonkerd 19, 20, 37.

6. LEMMAPHYLLUM

C. Presl, Epim. Bot.: 157. 1849.- *Weatherbya* Copel., Gen. Fil.: 191. 1947.

Rhizome long-creeping, slender, scaly. **Lamina** simple, usually dimorphic; sterile fronds usually smaller; veins hardly visible, copiously anastomosing with included free veinlets in areoles. **Sori** round or continuous along margin.

Lemmaphyllum carnosum (J. Sm. ex Hook.) C. Presl, Epim. Bot.: 158. 1894; Tagawa & K. Iwats., Fl. Thailand 3(4): 518. f. 52. 2-3. 1989.- *Drymoglossum carnosum* J. Sm. ex Hook., Gen. Fil.: pl. 78 A. 1841; Bedd., Handb.: 411. f. 243. 1969.- *Microsorium* sp.; Holttum, Dansk Bot. Ark. 20: 20. 1961.

Rhizome long-creeping, slender, about 1 mm diam., bearing many thickly brown- hairy root and fronds remotely about 1-3 cm or more, scaly; scales narrowly subtriangular, gradually narrowing from base towards long attenuate apex, round at base, up to 2 by 0.5 mm, clathrate, toothed at margin, pale brown. **Lamina** simple very shortly stalked. Sterile fronds: elliptic to ovate or ovate-oblong, acute to acuminate at apex, cuneate at base, up to 4-6 by 1-2 cm; midrib prominent, veins obscure, edges not toothed; texture coriaceous, cartilagineous at margin. Fertile frond: stipes up to 7 cm long, densely scaly at base; lamina linear, acuminate at apex, attenuate at base, about 6-7 by 3-4 cm. Sporangia covering the whole under surface of lamina except midrib and margin. **Fig. 6.127, 6.128**

Thailand.- NORTHERN: Chiang Rai, Chiang Mai (Doi Chiang Dao, Doi Suthep); NORTH-EASTERN: Loei (Phu Luang).

Distribution.- Himalayas (type from Nepal) to SW. China (Yunnan & Kwangsi) and N. Veitnam.

Ecology.- On tree-trunks or on moist rocks in Tropical evergreen forest to Hill evergreen forest at 960-1050 m altitudes.

Specimens examined.- BCU: Y. Yuyen 133, 183; P. Rachata 45, 185, 293.

7. LEPISORUS

(J. Sm.) Ching, Bull. Fan Mém. Inst. Biol. 4: 47. 1933.- *Drynaria & Lepisorus* J. Sm., Bot. Mag. 72. Comp. 13. 1848.- *Pleopeltis* Humb. & Bonpl. ex Willd., Sp. Pl.: 5: 211. 1810.

Rhizome creeping, scaly. **Stipes** articulated to rhizome. Lamina simple; veins usually invisible, copiously anastomosing with included free veinlets in areoles. **Sori** usually at junction of veins, rounded or rarely elongate, superficial or sunk in cavities, exindusiate.

Lepisorus scolopendrium (Buch.-Ham. ex D. Don) Mehra & Bir, Research Bulletin of the Panjab University, Science 15: 168. 1964; Tagawa & K. Iwats., Fl. Thailand 3 (4): 511. f. 51. 6. 1989.- *Polypodium scolopendrium* Ham. ex D. Don, Prodr. Fl. Nepal.: 1: 1825.- *Lepisorus excavatus* var. *scolopendrium* (Ham. ex D. Don) Ching, Bull. Fan Mém. Inst. Biol. 4: 69. 1933.- *Pleopeltis scolopendrium* (Ham. ex D. Don)

Alst. & Bonn., Candollea 15: 207. 1956.- *Polypodium excavatum* Bory ex Willd., Sp. 5: 158. 1810.

Rhizome creeping, bearing a few fronds closely, dark brown, about 4-5 mm diam., scaly; scales dense, appressed, thin, gradually narrowing towards acuminate apex, up to 6 by 1.5 mm, concolourous light brown, dark brown in central portion at base, clathrate, rather irregular at paler margin. **Stipes** short, indistinct, usually up to 1 cm long, brown, scaly at base. **Lamina** simple, linear-lanceolate, broadest at 1/3 part from base, up to 16-35 by 1.5-3 cm, gradually narrowing towards both ends, entire but various waved at margin; midrib raised on both surfaces; texture papyraceous, light green, glabrous; veins copiously anastomosing with branched included veinlets. **Sori** round to oblong, large, one between adjacent main veins, medial, up to 4 mm broad, never fused to the next ones, about 5-7 mm apart, the receptacles raised with hallow on upper surface. **Fig. 6.129**

Thailand.- NORTHERN: Chiang Rai (Doi Tung), Chiang Mai (Pong Pho, Doi Pha Hom Pok, Doi Chaing Dao, Doi Inthanon, Doi Suthep, Doi Hua Mot, Huai Mae Pan), Lamphun (Doi Khun Tan), Phitsanulok (Phu Miang); NORTH-EASTERN: Phetchabun Loei (Phu Luang); SOUTH-EASTERN: Chanthaburi (Khao Soi Dao); PENINSULAR: Surat Thani (Ban Don).

Distribution.- Himalayas (type) and Tibet, SW. China, Upper Myanmar and Indochina.

Ecology.- On mossy tree-trunks and branches in Hill evergreen forest at 1050 m altitudes.

Vernacular.- Kut chak khep (กูดจักเขีบ) (Northern).

Specimens examined.- BCU: Y. Yuyen 138; P. Rachata 250, 254; T. Boonkerd 1038, 1079.

8. LEPTOCHILUS

Kaulf., Enum.: 147. pl. 1. f. 10. 1824.- *Paraleptochilus* Copel., gen. Fil.: 198. 1947.

Terrestrial or on tree-trunks. **Rhizome** long-creeping, scaly. **Lamina** biserrate, articulate to rhizome, distinctly dimorphic; sterile lamina simple to laciniate; veins reticulate; fertile fronds prominently contracted, linear. **Sori** covering the whole undersurface of linear fertile laminae except on midrib and margin.

Key to the species

1. Fertile fronds subdimorphic, ovate oblong, about 10 by 3 cm; sporangia arranging in one row between adjacent main veins; margin flat **2. L. macrophyllus var. macrophyllus**
1. Fertile fronds dimorphic, linear, about 20 by 0.4 cm, sporangia covered entirely beneath; margin reflexed **1. L. decurrens**

1. Leptochilus decurrens Blume, En. Pl. Jav.: 206. 1828; Holttum, Rev. Fl. Malaya 2: 164. f. 74. 1955; Devol and Kuo, Fl. Taiwan vol 1. 2 nd ed. 189. pl. 65. 1980; Tagawa & K. Iwats., Fl. Thailand 3(4): 542. f. 54. 7. 1989.- *Acrostichum variabile* Hook., Sp. Fil. 5: 277. 1864.- *Gymnopteris variabilis* (Hook.) Bedd., Fern Br. Ind.: t. 272. 1868; Handb.: 429. f. 258. 1969.

Rhizome long-creeping or climbing a little above ground, up to 3-4 mm diam, bearing fronds more than 1 cm apart, densely scaly at apex; scales narrowly-subtriangular, gradually narrowing from base towards long tail at apex, up to 3 by 0.5 mm, distinctly clathrate, dark brown. **Fronds** dimorphic. **Sterile fronds:** simple, stipes up to 10 cm long, more or less winged at least on the upper part, sparsely scaly or glabrescent at lower portion, stramineous to brown, lamina oblong to oblong-lanceolate, broadest near base, broadly cuneate at base and decurrent downwards to form wings of stipes, gradually narrowing upwards and then caudately acuminate at apex, up to 25 cm long and 6 cm wide, entire or irregularly undulate at margin; midrib raised on both surface; main lateral veins distinct, the other veins visible, forming copious areoles with forked or branched included free veinlets; dark green. **Fertile fronds:** stipes up to 15-30 cm long, stramineous to brown, wingless, glabrous; lamina linear, up to 13-20 by 0.2-0.4 cm, covered entirely beneath with sporangia or sometime the border fronds not entirely covered, edges of fronds reflexed. **Fig. 6.138**

Thailand.- NORTHERN: Chiang Rai (Doi Phacho), Chiang Mai (Doi Chiang Dao,Tin Tok, Doi Suthep, Doi Inthanon), Lamphun (Doi Khun Tan), Mae Hong Son (Doi Loi Bian, Ban Pasui), Phrae (Huai Hom Noi), Lampang (Mae Tha); NORTH-EASTERN: Phetchabun (Phu Miang); SOUTH-WESTERN: Uthai Thani (Noen Pradu), Kanchanaburi (Kha Thalai); PENINSULAR: Nakhon Si Thamarat (Khao Luang).

Distribution.- S. India, Himalayas to S. China and Taiwan, Indochina, Malesia (Type from Java) and Polynesia Throughout.

Ecology.- Terrestrial on moist rocks or on basal tree trunks usually in Tropical evergreen forest at 800-1000 m altitudes.

Specimens examined.- BCU: Y. Yuyen 50, 73; P. Rachata 1, 16, 27; T. Boonkerd 509, 618, 632.

2. Leptochilus macrophyllus (Blume) Noot var. **macrophyllus**, Blumea 42: 286. 1997.- *Grammitis macrophylla* Bl., En. Pl. Jav.: 119. 1828.- *Colysis acuminata* (Bak.) Holttum Sensu Tagawa & K. Iwats., Acta Phytotax. Geobot. 23: 53. 1968.- *Colysis macrophylla* C. Presl, Epim. Bot.: 147. 1849; Holttum, Rev. Fl. Malaya 2: 160. f. 72. 1955; Tagawa & K. Iwats., Fl. Thailand 3(4): 538. 1989

Rhizome creeping or climbing, bearing fronds about 3-10 mm apart, 4 mm in diam., scaly; scales narrowly subtriangular, gradually narrowing from base towards long-tailed apex, about 2 by 0.5 mm, dark, clathrate, toothed at margin. **Fronds** simple, dimorphic. **Sterile fronds:** stipes about 3-10 cm long, winged on the upper part and sometime almost to the base; laminae oblong, usually gradually narrowing towards acute to acuminate apex, cuneate at base, edges entire, up to 13-20 cm long and 3-5 cm wide, widest near base which is rather abruptly narrowed to the wing of the stipe; main lateral veins distinct, up to 7 mm apart, veins forming areoles with included veinlets; texture herbaceous, green, dark in dry specimen, glabrous. **Fertile fronds:** stipes up to 23 cm long, castaneous, wingless, glabrous; laminae ovate-oblong, broadest at lower 1/3 portion cuneate at base, up to 10 by 2.5 cm. **Sori** up to 2 mm broad, continuous from midrib nearly to adges of fronds, arranging in one usually regular row between adjacent main veins. **Fig. 6.139**

Thailand.- PENINSULAR: Narathiwat (Sungai Padi), Yala (Khao Khalakhiri), Pattani (Ban Sai Khao).

Distribution.- Malesia (type from Java).

Ecology.- On moist rocks in deep shade or climbing on basal tree trunks in Tropical evergreen forest at 820 m altitudes.

Specimens examined.- BCU: Y. Yuyen 37; K. Lukchant 14; T. Boonkerd 351, 643.

9. LOXOGRAMME

(Bl.) C. Presl, Tent. Pterid.: 214. pl. 9. f. 8. 1836.

Rhizome short or long-creeping, scaly. **Lamina** not distinctly articulate, monomorphic to dimorphic, simple; main veins hardly distinct, veins all invisible, reticulate. **Sori** elongate, usually oblique to midrib, superficial or slightly immersed, naked.

Loxogramme avenia (Blume) C. Presl, Tent. Pterid.: 215. 1863; Holttum, Rev. Fl. Malaya 2: 167. f. 76. 1955; Bedd., Handb.: 393. f. 229. 1969; Tagawa & K. Iwats., Fl. Thailand 3(4): 576. 1989.- *Grammitis avenia* Bl., En. Pl. Jav.: 117. 1828.- *Loxogramme blumeana* C. Presl, Tent. Pterid.: 215. 1836.- *Loxogramme involuta* (D. Don) C. Presl sensu Holttum, Dansk. Bot. Ark. 23: 230. 1965.

Rhizome short creeping, about 3-5 mm diam., bearing fronds closely and many brown- hair roots, densely covered with scales near apex; scales dark brown, linear-lanceolate, narrowing towards hair-pointed apex, about 7 by 1 mm, entire; densely scaly at base, pale brown. **Stipes** narrowly winged to the very base. **Lamina** simple, lanceolate, acuminate at apex, broadest at middle to upper 1/3 portion, gradually narrowing downwards, about 40-50 by 4-4.5 cm; edges entire or a little recurved, green on upper surface, paler beneath; midrib distinct raised on upper surface, hardly so beneath, pale brown; vein hardly visible on both surfaces; texture thick, leathery, fleshy. **Sori** in the upper half of frond, linear, oblique, continuous from near midrib to the margin of fronds, up to 4 cm by 2 mm, slightly immersed. **Fig. 6.140, 6.141**

Thailand.- CENTRAL: Nakhon Nayok (Nang Rong Falls); SOUTH-EASTERN; Chanthaburi (Khao Sabap), Trat (Ko Chang); PENINSULAR: Chumphon (Ban Kraye), Phangnga (Takua Pa, Khao Katha Khwarn), Trang (Khao Chong), Satun, Narathiwat (Waeng), Yala (Ban Chana).

Distribution.- W. Malesia (type from Java), Indochina, also in Myanmar (Moulmein).

Ecology.- On moist rocks in Hill evergreen forest at 1050 m altitudes or on muddy cliffs along stream in Dry evergreen forest at 300 m altitudes.

Specimens examined.- BCU: Y. Yuyen 165; T. Boonkerd 633, 634, 635.

10. MICROSORUM

Link, Hort. Berol. 2: 110. 1833.

Rhizome creeping, densely scaly in apical portion. **Stipes** articulated to rhizome. Lamina simple and entire, lobed, hastate, or pinnate; veins anastomosing with free included veinlets in areoles. **Sori** round to oblong, usually small and scattered rarely fused, without peltate paraphyses.

Key to the species

1. Sori superficial, not sunk in cavities; fronds simple to pinnatifid
   2. Fronds usually simple, entire or slightly undulate
      3. Lateral main veins distinctly raised on both surface
         4. Sori in two regular rows between adjacent main veins; Lamina up to 5-5.5 cm wide **6. M. zippelii**
         4. Sori irregular scattered, abundant; lamina about 10 cm wide **2. M. heterocarpum**
      3. Lateral main veins hardly visible **5. M. punctatum**
   2. Fronds of well-grown plants deeply lobed
      5. Fronds simple to trifoliage; rhizome about 3 mm diam. **4. M. pteropus**
      5. Fronds pinnatifid, about 3 pairs of pinnae; rhizome up to 6-10 mm diam **1. M. dilatatum**
1. Sori sunk in cavities; fronds pinnatifid **3. M. nigrescens**

1. Microsorum dilatatum (Bedd.) Sledge, Bull. Brit. Mus. (Nat. Hist.) Bot. 2: 143. 1960; Devol and Kuo, Fl. Taiwan vol 1. 2 nd ed. 194. 1980; Tagawa & K. Iwats., Fl. Thailand 3(4): 530. 1989.- *Pleopeltis dilatata* Bedd., Ferns Brit. Ind.: t. 122. 1866; Handb.: 367. f. 209. 1969, based on *Polypodium dilatatum* Wall. ex Hook., Sp. Fil. 5: 85. 1863; *Microsorium hancockii* (Bak.) Ching, Bull. Fan Mém. Inst. Biol. 4:309. 1933; Holttum, Rev. Fl. Malaya 2: 174. f. 82. 1955.

Rhizome short-creeping, thick, about 6-10 mm diam., dark, bearing fronds closely, scaly; scales subtriangular, gradually narrowing towards long acuminate apex, round at base, up to 4 by 1 mm, dark brown, clathrate, decaying from outside, round to oblong ovate on older rhizome. **Stipes** up to 30-35 cm long distinctly winged nearly to the base, scaly at base, stramineous. **Lamina** simple to pinnatifid with 3 lobes, about 40 by 30 cm, ovate-triangular in outline, lobed to about 1 cm on each side of the midrib, basal lobes largest or sometime slightly reduced, the upper ones gradually becoming smaller, lobes oblique, oblong to narrowing oblong-lanceolate, caudate at

apex, entire, up to 20 by 4 cm, the terminal lobes oblong, gradually narrowing towards apex; rachis and midrib raised on both surface, sparsely scaly throughout on lower surface, main lateral veins distinct, the other veins visible, copiously anastomosing; texture papyraceous, light green, glabrous. **Sori** round, irregular scattered on the lower surface of fronds, about 1 mm diam. **Fig. 6.137**

Thailand.- NORTHERN: Chiang Rai (Doi Phacho), Chiang Mai (Doi Inthanon, Doi Khun Huai Pong), Mae Hong Son (Mae La Noi), Phrae (Mai Sai); NORTH-EASTERN: Loei (Phu Luang); SOUTH-EASTERN: Chanthaburi (Khao Soi Dao); PENINSULAR: Nakhon Si Thamarat (Khao Luang).

Distribution.- In Sri Lanka and Himalayas (type) to Malaya and Indochina.

Ecology.- On muddy rocks near stream in deep shade in Hill evergreen forest at 1050 m altitudes.

Specimens examined.- BCU: Y. Yuyen 45; T. Boonkerd 1335, 1345.

2. Microsorum heterocarpum (Blume) Ching, Bull. Fan. Mém. Inst. Biol. 4: 295. 1933; Holttum, Rev. Fl. Malaya 2: 178. f. 87. 1955; Tagawa & K. Iwats., Fl. Thailand 3(4): 526. 1989.- *Polypodium heterocarpum* Bl., Fl. Jav. Fil.: 167. t. 75. 1829.

Rhizome creeping, about 5 mm diam., bearing fronds rather closely, young part scaly; scales dull brown, ovate-oblong with gradually narrowing attenuate apex, up to 4 by 1 mm, dark brown, clathrate. **Stipes** up to 20-25 cm long, wing gradually widening upwards and merging into the lamina of frond, stramineous, scaly at base. **Lamina** simple, oblong-lanceolate, acuminate to attenuate at apex, broadest at middle or lower portion, cuneately narrowing and broadly deccurent downwards to the wings of stipes, subentire or undulate at margin, up to 50-70 tall including stipes, or about 50 by 10 cm, not distincly dimorphic but the soliferous fronds usually much taller with long stipes; lateral main veins distinct, the other veins visible, anastomosing to form copious areoles with included veinlets; texture papyraceous. **Sori** usually at junction of veinlets, with elongate receptacle, round or elongate, irregular scattered on the fronds underneath, sometime spreading a little or even confluent, about 1-4 mm long. **Fig. 6.135**

Thailand.- PENINSULAR: Trang (Khao Chong).

Distribution.- Malesia throughout (type from Java).

Ecology.- On moist rocks by stream in Tropical evergreen forest at 800 m. altitudes.

Specimens examined.- BCU: Y. Yuyen 70; T. Boonkerd 1334.

3. Microsorum nigrescencs (Blume) Copel., Occ. Pap. B. P. Bishop Mus. 14: 74. 1938; Tagawa & K. Iwats., Fl. Thailand 3(4): 532. 1989.- *Polypodium alternifolium* Willd., Sp. Pl. 5: 168. 1810.- *Polypodium nigrescens* Bl., En. Pl. Jav.: 126. 1828.- *Phymathodes nigrescens* (Bl.) J. Sm.: Ferns Br. For.: 94. 1866; Holttum, Rev, Fl. Malaya 2: 193. f. 95. 1955.- *Pleopeltis nigrescens* (Bl.) Carr. in Seem., Fl. Vit.: 368. 1873; Bedd., Handb.: 367. f. 208. 1969.- *Micrsorium alternifolium* (Willd.) Copel., Gen. Fil.: 197. 1947.

Rhizome creeping, thick, about 1 cm diam., scaly; scales circular to oblong, round to moderate acute at apex, round at base, attached near the center, minutely hairy at the margin, about 5 by 4 mm, brown, more or less clathrate with thick internal cell-wall, the internal wall gradually becoming thiner outwards. **Stipes** up to 45-50 cm long, stramineous. glabrous. **Lamina** pinnatisect nearly to rachis, acute at apex in outline, up to 75 cm long and 45 cm wide; lateral pinnae longest at base, or the basl most ones slightly reduced, becoming smaller upwards, oblong, long acuminate at apex, up to 28 by 3.5 cm, subentire at margin, more or less ascending, usually straight, some what narrowing towards base, up to 10 pairs; vein all distinct, forming areoles; texture papyraceous, deep green. **Sori** round in distinct hallows in one row at each side of costa about 2 mm diam., distinctly raised on upper surface. **Fig. 6.136**

Thailand.- EASTERN: Chaiyaphum (Nam Phrom, Pku Khieo), Nakhon Ratchasima (Pak Thong Chai); SOUTH-EASTERN: Prachin Buri (Khao Yai), Chanthaburi (Takhamao Falls, Khao Sabap, Khao Soi Dao), Trat (Ko Chang); SOUTH-WESTERN: Kanchanaburi (Khao Ri Yai, Ban Ti Li), Prachuap Khiri Khan (Ban Huai Ta, Ban Sai Khao); PENINSULAR: Chumphon (Tha Ngo), Phangnga (Khao Katha Khwam, Khao Phra Mi), Nakhon Si Thamarat (Cha Wang, Khao Luang, Khiriwong), Trang (Khao Chong), Satun, Pattani, Narathiwat (Waeng, Bacho, Sungai Padi, Bacho Falls), Yala (Bannang Sata).

Distribution.- Sri Lan Ka, S. India, Vietnam, Cambodia, throughout Malesia (type from Java) and Polynesia.

Ecology.- On rather dry rocks in Dry evergreen forest at 420 m. altitudes.

Vernacular.- Ka-lora-wa (กาโลระวา) (Malay/Peninsular).

Specimens examined.- BCU: Y. Yuyen 29, 103; T. Boonkerd 6, 637, 644.

4. Microsorum pteropus (Blume) Copel., Univ. Calif. Publ. Bot. 16: 112. 1929; Holttum, Rev. Fl. Malaya 2: 172. f. 80. 1955; Devol and Kuo, Fl. Taiwan vol 1. 2 nd ed. 196. 1980; Tagawa & K. Iwats., Fl. Thailand 3(4): 529. 1989.- *Polypodium pteropus* Bl., En. Pl. Jav. 2: add. 3. 1828.- *Pleopeltis pteropus* (Bl.) Bedd., Handb. 359. f. 203. 1883.

Rhizome creeping, about 3 mm diam., bearing fronds rather closely, the young part densely scaly; scales oblong-lanceolate, gradually narrowing toward apex, round at base, up to 3 by 1 mm, dark brown, the wall of the narrow cells raised, forming a distinct network, the cell rather regularly arranged longitudinally, the margin entire. **Stipes** stramineous, with the scales like those on rhizome but smaller in size, up to 14 cm long, grooved above, winged on upper portion. **Lamina** simple to trifoliate, simple laminae to about 15 cm long 3.5 cm wide, broadest at lower 1/3 portion, narrowing towards attenuatelly very long acuminate apex, entire; trilobed fronds various in size and form, shaped like the simple fronds, lateral lobes free almost to the base, to about 9 cm long, shaped like the terminal lobe but always much narrower; all lobes scaly on the midrib beneath; veins distinct, anastomosing with a row of main areoles along both sides of midrib and many smaller areoles in irregular arrangement; texture thinly papyraceous, dark green to blackish in colour. **Sori** round to more or less elongate, many, irregular scattered on the under surface of fronds. **Fig. 6.133**

Thailand.- NORTHERN: Chiang Rai (Mae Lao), Chiang Mai (Doi Chiang Dao, Doi Saket), Lampang (Mae Long), Phitsanulok (Thung Salaeng Luang), Tak; NORTH-EASTERN: Loei (Phu Luang); EASTERN: Buri Ram (Bu Khanun), Chaiyaphum; CENTRAL: Nakhon Nayok (Khao Yai), Saraburi (Muaklek); SOUTH-EASTERN: Chanthaburi (Pong Nam Ron); SOUTH-WESTERN: Rachaburi, Kanchanaburi (Khao Ri Yai), Prachuap Khiri Khan (Huai Yang); PENINSULAR: Chumphon (Ban Tha Ngo), Ranong (Mueang Laen), Surat Thani (Ko Samui, Ban Don), Nakhon Si Thamarat (Khao Luang, Thap Chang, Khiriwong), Trang (Khao Chong), Satun (Bukit Racha Wang), Yala (Bannang Sata).

Distribution.- India to Malesia (type from Java), north to S. China and the Ryukyus.

Ecology.- On wet rocks in Mixed deciduous forest at 160 m altitudes usually in spraying water.

Specimens examined.- BCU: Y. Yuyen 99, 105, 116, 160; P. Rachata 289; T. Boonkerd 538, 1185.

5. Microsorum punctatum (L.) Copel., Univ. Calif. Publ. Bot. 16: 111. 1929; Holttum, Rev. Fl. Malaya 2: 179. 1955; Devol and Kuo, Fl. Taiwan vol 1. 2 nd ed. 197. 1980; Tagawa & K. Iwats., Fl. Thailand 3(4): 528. 1989.- *Acrostichum punctatum* L., Sp. Pl. ed. 2: 1524. 1763.- *Polypodium punctatum* (L.) Sw., Schrad. J. Bot. 1800 (2): 21. 1801.- *Pleopeltis punctata* (L.) Bedd., Ferns Brit. Ind. Suppl.: 22. 1876; Handb.: 357. f. 201. 1969.

Rhizome creeping, about 3-5 mm diam., dark or glaucous in surface, bearing many densely roots and fronds close together, rather sparsely scaly except at the apex; scales narrowly oblong-subtriangular, gradually narrowing from broad round base to acute at apex, dark dull brown, clathrate, the surface wall of constituent cell not transparent, margin distinctly toothed, up to 2 by 1 mm. **Stipes** not distinct from laminae, usually about 1-5 cm long, sometime larger, scaly at base, stramineous to greenish. **Lamina** simple, narrowing oblong to lanceolate, gradually narrowing towards acute to acuminate apex or obtuse apex, narrowing towards attenuate base and decurrent downwards to form wing of stipes sometime nearly to the base, up to 40-50 by 4-5 cm; midrib raised on both surface, other veins obscure, finely anastomosing to form copious areoles to the base, to about 9 cm long, shaped like the terminal lobe but always much narrower; all lobes scaly on the midrib beneath; veins distinct, anastomosing with a row of main areoles along both sides of midrib and many smaller areoles; texture coriaceous, rather pale green, the margin of fronds entire or some time revoluted. **Sori** small, round, many, scattered on the whole under surface of fronds, about 1 mm diam. **Fig. 6.134**

Thailand.- NORTHERN: Chiang Rai (Mae Kok), Chiang Mai (Fang, Doi Chiang Dao,Tin Tok, Mae Rim, Doi Inthanon), Lampang (Mae Ngao), Phitsanulok (Salaeng Haeng, Thung Salaeng Luang), Tak (Lan Sang, Doi Musoe); NORTH-EASTERN: Phetchabun (Phu Miang), Loei (Phu Luang, Phu Kradueng); EASTERN: Chaiyaphum (Phu Khieo); SOUTH-EASTERN: Prachin Buri (Khao Yai), Chon Buri (Si Racha, Hup Bon), Nakhon Ratchasima (Pak Thong chai, Khao Chong),

Chanthaburi (Takhamao Falls, Makham, Khao Kluea), Trat (Ban Saphan Hin, Ko Chang, Ko Kut); SOUTH-WESTERN: Kanchanaburi (Khao Ri Yai, Wangka, Sai Yok), Prachuap Khiri Khan (Bang Saphan); PENINSULAR: Ranong (Kra Buri, Klong Nakha), Surat Thani (Ban Don), Phangnga (Klong Nang Yon), Phu Ket, Nakhon Si Thamarat (Khao Luang, Thong Song), Trang (Khao Chong), Yala (Khao Khalakhiri, Bannang Sata).

Distribution.- Throughout the tropics of the world, W. Africa to Tahiti.

Ecology.- Terrestrial or on muddy rocks in dry open places or in light shade in Mixed deciduous forest or Dry evergreen forest at 360 m. altitudes.

Vernacular.- Kra prok hang sing (กระปรอกหางสิงห์) (South-easthern); Prue mai (ปรือไม้) (South-western); Lin phi mai (ลิ้นผีไม้); Hang nok wa (หางนกหว้า) (Peninsular); Ai-ka bu-kong ka-waeng (ไอกาบุกงกะแวง) (Malay/Peninsular).

Specimens examined.- BCU: Y. Yuyen 7; T. Boonkerd 123, 124, 172, 1525.

6. <u>Microsorum</u> <u>zipelii</u> (Blume) Ching, Bull. Fan Mém. Inst. Biol. 4:308. 1933; Holttum, Rev, Fl. Malaya 2: 176. f. 85. 1955; Tagawa & K. Iwats., Fl. Thailand 3(4): 525. 1989.- *Polypodium zippelii* Bl., Fl. Jav. Fil.: 172. t. 80. 1829.- *Pleopeltis zippelii* (Bl.) T. Moore, Ind.: 348. 1862; Bedd., Handb.: 357. 1969.

Rhizome creeping, about 3 mm diam., bearing fronds more than 1 cm apart, densely scaly; scales narrowly oblong-subtriangular, narrowing attenuate apex, up to 4 by 1.5 mm, brown, the central cells larger and thick-walled, the apical portion with longitudinal cells with toothed margin. **Stipes** winged almost to the base, the wing gradually widening upwards and merging into lamina of the frond, up to 7 cm long, stramineous, scaly at base. **Lamina** simple, oblong-lanceolate, acuminate at apex, broadest at middle or lower portion, gradually narrowing towards long-attenuate base, subentire at margin, about 25-35 cm long and 5-5.5 cm wide, midrib raised on both surface, finely anastomosing to form copious areoles with included veinlets; texture papyraceous, green above and pale below, glabrous. **Sori** round usually at junction of veinlets, arranging in to rows between main veins, about 1 mm diam. **Fig. 6.132**

Thailand.- NORTHERN: Chiang Rai (Mae Len), Chiang Mai (Doi Chiang Dao); NORTH-EASTERN: Loei (Phu Luang).

Distribution.- Himalayas to Malesia throughout (type from Java), northeast to S. China (Hainan) and Indochina.

Ecology.- In muddy crevices of rocks or on mountain slopes by stream in dry eveergreen forest at 400 m altitudes.

Specimens examined.- BCU: Y. Yuyen 10; P. Rachata 44; T. Boonkerd 142, 144, 1159.

11. NEOCHEIROPTERIS

H. Christ, Bull. Soc. Bot. France 62 Mém. 1: 21. 1905.- *Neolepisorus* Ching, Bull. Fan Mém. Inst. Biol. 10: 11. 1940.

Rhizome long creeping, rather fleshy, scaly. **Stipes** jointed to rhizome. **Lamina** simple, lobed or pedate; veins anastomosing with free included veinlets in areoles. **Sori** round, somewhat irregularly arranging in one or two rows between midrib and the margin of leaves.

Neocheiropteris normalis (D. Don) Tagawa, J. Jap. Bot. 27: 217. 1952; Tagawa & K. Iwats., Fl. Thailand 3(4): 523. f. 52. 7-8. 1989.- *Polypodium normale* D. Don, Prodr. Fl. Nepal.: 1. 1825.- *Pleopeltis normalis* (D. Don) T. Moore, Ind.: 347. 1862; Bedd., Handb.: 353. 1969.- *Microsorium normale* (D. Don) Ching, Bull. Fan Mém. Inst. Biol. 4: 299. 1933; Holttum, Rev. Fl. Malaya 2: 175. f. 83. 1955.- *Neolepisorus normalis* (D. Don) Ching, Bull. Fan Mém. Inst. Biol. 10: 13. 1940.

Rhizome long-creeping, somewhat flattened, about 4-5 mm diam., bearing fronds with irregular intervals, 0.5-2 cm remote, densely scaly throughout; scales small, ovate, round at base, about 1 mm broad, pale brown, with a tuft of stiff red-brown hairs on the upper surface at the point of attachment of the peltate base up to 1 mm in length. **Stipes** up to 2-4 cm long, winged at upper part, scaly at lower portion, stramineous. **Lamina** simple, linear-lanceolate, long acuminate at apex, broadest at middle portion, narrowed gradually to both ends, entire and flat or slightly waved at margin, up to 30-43 by 3-4.5 cm; midrib distinctly raised on both surface, sparsely scale at lower portion; lateral veins distinctly in lower surface, copiously anastomosing; texture subcoriaceous, glabrous, the margin of fronds cartilagineous. **Sori** rather irregular in one row between midrib and the margin of fronds, costular, round, up to 3 mm diam. **Fig. 6.130**

Thailand.- NORTHERN: Chiang Rai (Doi Khun Huai Pong, Doi Inthanon), Phitsanulok (Phu Miang); NORTH-EASTERN: Loei (Phu Luang); SOUTH-EASTERN: Chanthaburi (Khao Soi Dao); SOUTH-WESTERN: Kanchanaburi (Khao Ri Yai).

Distribution.- Himalayas (type from Nepal), Upper Myanmar, S. China, Vietnam and W. Malesia (Malaya and Sumatra).

Ecology.- Scandent on tree-trunks in Hill evergreen forest at 1050 m altitudes.

Vernacular.- Kut chak khep (กูดจักเข็บ) (Chiang Mai).

Specimens examined.- BCU: Y. Yuyen 48; T. Boonkerd 83, 1051, 1348.

12. PLATYCERIUM

C. Presl, Epim. Bot.: 157. 1849.- *Weatherbya* Copel., Gen. Fil.: 191. 1947.

Epiphytic plants. **Rhizome** covered by mass of fronds and roots, short-creeping, scaly. **Fronds** dimorphic; Nest-leaves: erect, sessile, shallowly lobed dichotomously; Fertile-leaves erect or pendulous, articulate at base, repeatedly forked dichotomously; veins anastomosing with branched included veinlets. **Sporangia** spreading on specialized areas of fertile leaves.

Platycerium holttumii Jonch. & Hennipman, Brit. Fern Gaz. 10: 116. pl. 12, f. 1-3. 1970; Tagawa & K. Iwats., Fl. Thailand 3(4): 489. 1989.- *Platycerium grande* J. Sm. ex Hook. sensu Bedd., Handb.: 445. f. 271. 1883.

Rhizome short-creeping, bearing frond densely covered with scales; scales oblong, gradually narrowing towards apex, up to 14 cm long by 2 mm broad, brown, stiff, fimbriate. **Nest-leaves:** 40 cm or more in length, as wide as long, dichotomously lobed, deepest sinus, lobed rounded to moderate acute at apex, larger than wide; main veins dichotomous, secondary ones forming network, smaller ones more copiously anastomosing; texture very thick and fleshy near base, thin and green at upper portion. **Fertile-leaves:** up to 75-90 cm or more long, pendulous, repeatedly dichotomously branching, the base broadly cuneate, shortly stalked; ultimate lobed narrrow, up to 25 by 4 cm, entire; main veins distinct, dichotomously branched, copiously anastomosing with included veinlets; texture thick, pale green, densely stellate hairy; a large area of

the lower surface in the basal sinus covered with sporangia, mixed with stellate paraphyses. **Fig. 6.131**

Thailand.- NORTHERN: Chiang Mai (Fang, Ban Huai Bong), Tak; NORTH-EASTERN: Nong Khai (Pak Cheng), Loei (Ban Na Luang); EASTERN: Chaiyaphum (Nam Phrom), Nakhon Ratchasima (Khao Yai, type); SOUTH-EASTERN: Chanthaburi (Khao Phra Bat); SOUTH-WESTERN: Kanchanaburi (Erawan Falls).

Distribution.- Indochina and Malaysia.

Ecology.- Epiphytic fern on tree trunk in light shade in Dry evergreen forest at 390 m altitudes.

Venacular.- Chai pha sida (ชายผ้าสีดา) (Central); Holttum's staghorn fern.

Specimens examined.- BCU: Y. Yuyen 118; T. Boonkerd 120, 180, 563.

13. POLYPODIUM

L., Sp. Pl. 2: 1082.- *Goniophlebium* (Bl.) Pres, Tent. Pterid.: 185. 1836.

Rhizome long-creeping, densely scaly. **Stipes** articulated to rhizome at phyllopodes. **Lamina** deeply pinnatifid to 1-pinnate; veins free and once forked, or anastomosing to form regular areole 1 to 4 rows at each side of costa, including a single free vein veinlet running outwards towards margin. **Sori** on acroscopic branch of forked veins or terminal on included free veins, usually in one row along costa.

Polypodium subauriculatum Blume, En. Pl. Jav.: 133. 1828; Holttum, Rev. Fl. Malaya 2: 207. f. 108. 1955; Tagawa & K. Iwats., Fl. Thailand 3(4): 573. 1989.- *Goniophlebium subauriculatum* (Bl.) C. Presl, Tent. Pterid.: 186. 1836; Bedd., Handb.: 323. f. 173. 1969.

Rhizome more slender, long-creeping, about 3 mm diam., distinctly glaucous, densely scaly; scales narrowly subtriangular, about 4 by 0.5 mm, brown clathrate, toothed at margin. **Stipes** stramineous to brown, about 10-30 cm long, densely scaly at base, sparsely scales upwards. **Lamina** imparipinnate, oblong-lanceolate in outline, up to 40-120 by 20-40 cm; rachis brown, minutely scaly throughout; lateral pinnae 23-32 pairs, jointed to rachis, a few basal pairs usually a little shorter than the next above, deflexed or patent, middle ones the largest, subopposite, sessile, linear, subcordate or subtruncate roundly auricled on both side at base, gradually narrowing from base to long attenuate apex, serrate at margin, up to 10-20 by 1.5 cm, upper pinnae gradually

becoming smaller, terminal pinna not so large, up to 3-7 cm long, irregularly lobed at basal portion or serrate throughout; vein anastomosing to form 3 rows of areoles at each side of costa, more or less visible; texture herbaceous, greenish to deep green, glabrous. **Sori** terminal on simple included veinlets in costal areoles, in one row at each side of costa, about 1 mm diam., distinctly immersed and raised on the upper surface. **Fig. 6.142**

Thailand.- NORTHERN: Chiang Rai (Doi Phacho, Mae Lao, Pong Pa Phon), Chiang Mai (Fang, Doi Chaing Dao, Doi Inthanon, Doi Suthep), Mae Hong Son (Doi Pha Dam), Lampang (Doi Luang), Tak (Mae Sot); NORTH-EASTERN: Phetchabbun (Phu Miang), Loei (Phu Luang, Phu Kradueng); SOUTH-EASTERN: Prachin Buri (Khao Yai), Chanthaburi (Khao Soi Dao); SOUTH-WESTERN: Kanchanaburi (Sai Yok, Khao Nam Tok).

Distribution.- NE. India, SW. China, Laos, Vietnam, Malesia Throughout (type from Java) to Australia (Queensland); also in the Tenasserim.

Ecology.- On tree-trunks or on mossy rocks in light shade in Dry evergreen forest or in Tropical evergreen forest to Hill evergreen forest at 230-1050 m altitudes.

Specimens examined.- BCU: Y. Yuyen 58, 66, 92, 112, 128; T. Boonkerd 539, 540, 1230, 1402.

14. PYRROSIA

Mirbel, Hist. Nat. Veg. 5: 91. 1803.- *Nipholobus* Kaulf., Enum. Fil.: 124. 1824.

Rhizome slender, long-creeping, scaly. **Lamina** simple to palmately lobed; veins anastomosing, completely hidden; surface more or less entirely covered with stellate hairs. **Sori** round, single row or more commonly in several close rows at each side of midrib or acrostichoid, naked, but protected when young by a dense matt of stellate hairs.

Key to the species

1. Fronds not or hardly dimorphic
   2. Upper surface of laminae lacking any hydathodes; lateral veins hardly visible **3. P. nuda**
   2. Upper surface of laminae with distinct hydathodes; lateral veins distinct
      3. Rhizome short-creeping; laminae lanceolate, up to 30-56 by 2.5-6 cm; texture subcoriaceous; upper surface glabrescent. **4. P. stigmosa**
      3. Rhizome long-creeping; laminae oblong-lanceolate, up to 15 by 3 cm; texture coriaceous; upper surface sparsely stellate hairs. **2. P. eberhardtii**

1. Fronds dimorphic or nearly so, with longer fertile fronds; sterile lamina oblong or broadly lanceolate, up to 10-12 cm long **1. P. adnascens**

1. Pyrrosia adnascens (Sw.) Ching, Bull. Chin, Bot. Soc. 1: 45. 1935; Holttum, Rev. Fl. Malaya 2: 144. f. 60. 1955; Devol and Kuo, Fl. Taiwan vol 1. 2 nd ed. 205. 1980; Tagawa & K. Iwats., Fl. Thailand 3(4): 496. 1989.- *Polypodium asnascens* Sw., Syn. Fil.: 25, 222. pl. 2. f. 2. 1806.- *Cyclophorus adnascens* (Sw.) Desv., Berl. Mag. 5: 300. 1811.- *Niphobolus adnascens* (Sw.) Kaulf., Enum.: 124. 1824; Bedd., Handb.: 325. f. 176. 1969.- *Pyrrosia lanceolata* (L.) Farw.; Hovenk., Leid. Bot. Ser.: 9: 191. 1986.

Rhizome long-creeping, 1-5 mm diam., bearing fronds 0.5-3 cm apart, dark brown, scaly throughout; scales appressed, oblong-lanceolate, round at base, long acuminate at apex, up to 2 mm long, narrower evenly from the peltate base, dark brown in central portion, gradually paler outward to pale margin, hairy at upper portion. **Fronds** simple, typically dimorphic. **Sterile fronds:** stipes about 1-2 cm long, scaly at base, stellate hairy, dark brown at base pale green upwards; laminae oblong-lanceolate, round at apex, gradually narrowing towards base, up to 4-6 by 0.5-1 cm; midrib grooved on upper surface, raised beneath, pale green, upper surface bearing small scattered stellate hairs, lower surface bearing scattered appressed stellate hairs with red-brown centre and very short pale arms, veins not visible. **Fertile fronds:** longer than sterile fronds, stipe up to 4 cm long, laminae up to 10-12 by 0.5-1 cm, acute at apex. sporangia covering the whole lower surface of apical half, becoming narrow in soriferous portion; sori close, naked, covered with stellate hairs only when young edges of fertile part of frond curving backwards when dried. **Fig. 6.144**

Thailand.- NORTHERN: Chiang Rai (Chiang Khong, Mae Suai), Chiang Mai (Fang, Doi Chiang Dao, Mae Rim, Doi Inthanon, Doi Saket, Doi Suthep, Mae Klang. Sop Aep), Lampang (Khao Tham Pha Thai), Phitsanulok (Thung Salaeng Luang), Tak (Ban Musoe, Huai Krasa, Lan Sang); NORTH-EASTERN: Loei (Phu Luang, Phu Kradueng, Pha Nam Thop), Khon Kaen (Pha Nok Khao), Nong Khai (Ban Kun Ka), Mukdahan; EASTERN: Nakhon Ratchasima (Khao Lotueng), Chaiyaphum (Tat Ton, Phu Khieo), Buri Ram (Chan Thuek); CENTRAL: Saraburi (Muak Lek), Nakhon Nayok (Khao Yai); SOUTH-EASTERN: Chon Buri (Si Racha, Ko Sichang), Chanthaburi (Makham, Khlung, Laem Sing, Khao Sabap), Trat (Ban Saphan Hin, Ko Chang, Ko Rang Yai); SOUTH-WESTERN: Kanchanaburi (Erawan), Prachuap Khiri Khan (Huai Yang, Bang Saphan); PENINSULAR: Ranong (Khao Sai Daeng), Surat

Thani (Ko Tao, Ko Kut, Ban Don), Phangnga (Takau Tung, Ko Kho Khao, Thung Maphrao, Khao Similan), Phu Ket (Ko Phu), Nakhon Si Thamarat (Khiriwong, Chawang, Khao Luang), Trang (Khao Chong), Phatthalung, Narathiwat (Bacho Falls), Yala (Bannang Sata).

Distribution.- Widely distribution in the tropics of Asia, India to S. China, Indochina, Taiwan and the Ryukyus, Malesia throughout to Polynesia.

Ecology.- Epiphyte on tree trunk or on rocks in open places or in light shade in Mixed deciduous forest or in Dry evergreen forest at 250-650 m altitudes.

Specimens examined.- BCU: Y. Yuyen 20, 68; P. Rachata 158; T. Boonkerd 636, 648, 1127, 1560.

2. Pyrrosia eberhardtii (H. Christ) Ching, Bull. Chin., Bot. Soc. 1: 59. 1935; Tagawa & K. Iwats., Fl. Thailand 3(4): 505. f. 50. 9-10. 1989.- *Cyclophorus eberhardtii* H. Christ, J. Bot. France 21: 237, 270. 1908.- *Pyrrosia manii* (Gies.) Ching et *Pyrrosia stigmosa* (Sw.) Ching sensu Holttum, Dansk Bot. Ark. 20: 19. 1961.- *Pyrrosia lingua* (Thunb.) Farw. var. *heteractis* Hovenk., Blumea 30: 208. 1984.

Rhizome long-creeping, 3 mm diam., bearing fronds 3-6 cm apart, densely scaly throughout; scales appressed in older portion and patent in upper part especially in younger portion, narrowly subtriangular, gradually narrowing from broadest peltate portion towards attenuate apex, up to 5 by 1 mm, bicourlour with nearly black basal portion and brown marginal portion, entire at margin, bearing long downy hairs at margin of apical portion. **Stipes** up to 20 cm long, scaly at base with those like rhizome scales, densely hairy throughout, greenish to brown at basal portion. **Lamina** simple, oblong-lanceolate, acuminate at apex, cuneate at base, about 15 cm long and 3 cm broad, midrib and main veins distinct, raised beneath, vein hardly visible; texture coriaceous, the upper surface very sparsely stellate hairy, with scattered hydathodes, greenish, lower surface densely covered with dense mat of stellate hairs greyish in colour. **Sori** round, distinct, scattered on all lower surface or in upper part of it, embeded in stellate hairs, brown, not confluent. **Fig. 6.146**

Thailand.- NORTHERN: Chiang Rai (Doi Tung), Chiang Mai (Doi Pha Hom Pok, Doi Chiang Dao, Doi Inthanon, Doi Suthep, Pha Mon), Phitsanulok (Phu Miang, Thung Salaeng Luang); NORTH-EASTERN: Loei (Phu Luang, Phu Kradueng, Phu Paek); CENTRAL: Nakhon Nayok (Khao Yai); SOUTH-EASTERN: Chanthaburi

(Khao Soi Dao), Trat (Khao Kuap); SOUTH-WESTERN: Kanchanaburi (Si Sawat); PENINSULAR: Nakhon Si Thammarat (Khao Luang, Khao Phra Mi), Phangnga (Khao Phota Luang Kaeo), Trang (Khao Chong).

Distribution.- S. China (Hainan) and Vietnam (type).

Ecology.- On rocks in exposed places or on mossy tree trunks in light shade in Hill evergreen forest at 1050 m altitudes.

Vernacular.- Lin kuram (ลิ้นกุรัม) (Eastern)

Specimens examined.- BCU: Y. Yuyen 82, 139, 155; K. Sridith 15; T. Boonkerd 588, 673, 1401, 1263.

3. Pyrrosia nuda (Giesenh.) Ching, Bull. Chin, Bot. Soc. 1: 70. 1935; Tagawa & K. Iwats., Fl. Thailand 3(4): 499. f. 50. 3. 1989.- *Niphobolus nudus Gies.*, Niph.: 149. 1901.- *Pyrrosia lanceolata* (L.) Farw.; Hovenk., Leid. Bot. Ser. 9: 191. f. 25. 1986.

Rhizome slender, long-creeping, bearing fronds 2.5-3 cm apart, up to 5 mm diam., densely scaly throughout; scales spreading, lanceolate, attenuate at apex, up to 5 mm long, 1 mm broad, dark brown in central portion, paler at margin, bearing pale downy hairs at margin of apical part. **Stipes** up to 1-2 cm long, greenish, scaly at base, densely stellate hairy throughout. **Lamina** simple, hardly dimorphic, oblong-lanceolate, acuminate at apex, cuneate at base, 9-14 cm long and 1 cm broad; midrib raised beneath, grooved on upper surface, stramineous to pale green; veins hardly visible; texture coriaceous, green, both surface very sparsely hairy; fertile fronds narrower and longer. **Sori** round, distinct or close to the neighbourings, covering the whole lower surface of the upper part of fronds except midrib. **Fig. 6.143**

Thailand.- NORTHERN: Tak (Ban Musoe, Khao Phra Wo).

Distribution.- Himalayas (type from Assam), Myanmar, SW. China (Yunnan), Veitnam and Laos.

Ecology.- On mossy tree-trunks in Dry evergreen forest at 450 m altitudes.

Specimens examined.- BCU: Y. Yuyen 182; T. Boonkerd 590, 671.

4. Pyrrosia stigmosa (Sw.) Ching, Bull. Chin., Bot. Soc. 1: 67. 1935; Holttum, Rev. Fl. Malaya 2: 148. 1955; Tagawa & K. Iwats., Fl. Thailand 3(4): 504. 1989.- *Polypodium stigmosum* Sw., Schrad. J. Bot. 1800(2): 21. 1801.- *Niphobolus stigmosus* (Sw.) T. Moore, Ind.: 276. 1861; Bedd., Handb.: 328. f. 178. 1969.

Rhizome short-creeping, bearing fronds closely, about 5 mm diam., dark brown to nearly black, densely scaly at apical portion; dark brown throughout, about 4 mm long, 1 mm broad, ovate with long tails, edges entire, cell walls clearly visible. **Stipes** up to 10-37 cm long, densely hairy throughout, brown. **Lamina** simple, lanceolate, about 30-56 cm long and 2.5-6 cm broad, widest at or above the middle, base narrowly cuneate, apex narrowly acuminate; texture subcoriaceous, the upper surface glabrescent, green with many scattered hydathodes, lower surface densely covered with a close felt of small interlacing light brown stellate hairs; midrib and main veins distinct, grooved above and strongly raised beneath, veins hardly visible. **Sori** round, covering the whole upper portion of the fronds underneath. **Fig. 6.145**

Thailand.- NORTHERN: Chiang Rai (Phu Langka), Chiang Mai (Fang, Doi Chaing Dao), Mae Hong Son, Lampang (Mae Mo, Mae Long, Ngao, Tham Pha Thai), Tak (Khao Phra Wo, Lan Sang, Huai Krasa, Rahaeng), Phitsanulok (Thung Salaeng Luang); NORTH-EASTERN: Loei (Phu Luang), Nakhon Phanom, Mukdahan; CENTRAL: Saraburi (Muak Lek, Khao Khao), Nakhon Nayok (Nang Rong); SOUTH-EASTERN: Prachin Buri (Ban Hills), Chanthaburi (Takhamao Falls); SOUTH-WESTERN: Kanchanaburi (Huai Ban Kao, Linthin, Sai Yok), Prachuap Khiri Khan (Huai Yang); PENINSULAR: Chumphon (Tha Ko), Surat Thani (Khao Hua Khwai, Khao Na Daeng), Phangnga (Thap Put), Yala (Bannang Sata).

Distribution.- Myanmar, Indochina and southwards to W. & C. Malesia (type from Java).

Ecology.- On dry to moist rocks usually in light shade in Dry evergreen forest at 230-270 m altitudes.

Specimens examined.- BCU: Y. Yuyen 61, 62; P. Rachata 75; T. Boonkerd 597, 1202, 1221.

GRAMMITIDACEAE

Devol., Fl. Taiwan vol. 1. 2nd ed.: 216. 1980.

Small epiphytes or rock-plants with short-creeping or ascending dorsiventral rhizome. **Lamina** simple or pinnatifid, or pinnate with sessile pinnae; veins free. **Sori** round or elliptic, superficial or sunk in cavities; sporngia often bearing stiff bristles.

Key to the genera

1. Fronds simple, entire or nearly so **2. Grammitis**
1. Fronds lobed more than halfway to midrib, with a main vein and pinnately arranged veinlets **1. Ctenopteris**

1. CTENOPTERIS

Blume, Schrad. J. Bot. 17. 1801.

Rhizome short, scaly. **Lamina** pinnate or rarely pinnatifid or bipinnate; veins pinnate , not simple nor once forked. **Sori** one to several on a pinna, terminal on vein.

Ctenopteris mollicoma (Nees & Blume) Kunze, Bot. Zeit. 425: 1846; Holttum, Rev. Fl. Malaya 2: 226. f. 124. 1955; Tagawa & K. Iwats., Fl. Thailand 3(4): 588. 1987.- *Polypodium mollicomum* Nees & Bl., Nova Acta 11: 121. t. 12. 1823.

Rhizome very short, erect, bearing frond in tuft at apex, scaly; scales lanceolate, acute to acuminate at apex, about 4 by 0.5 mm, hairy at margin with setose castaneous hairs, bright brown, rather thick. **Stipes** up to 0.5 cm long, dark brown, densely covered with patent, setose, castaneous hairs. **Lamina** lanceolate, gradually narrowing towards both the apex and the base, up to 10 by 1.5 cm, deeply pinnatisect nearly to rachis; pinnae oblique narrowly subtriangular, usually gradually narrowing toward moderately acute apex, entire, 7 mm long, 2 mm broad, the basiscopic base more or less decurrent to rachis; veins hardly visible; texture papyraceous, lower surfaces rather densely hairy, hairs setose, castaneous, those on upper surface hairy at rachis only and shorter. **Sori** round, sometimes touching to the next ones when mature, medial, up to 1 mm diam. **Fig. 6.147**

Thailand.- PENINSULAR: Nakhon Si Thammarat (Khao Luang), Yala (Gunong Ina).

Distribution.- W. Malesia (type from Java).

Ecology.- On mossy rocks or on tree-trunks in Hill evergreen forest at 1050 m altitudes.

Specimens examined.- BCU: Y. Yuyen 51, 137.

2. GRAMMITIS

SW., Schrad. J. Bot. 17. 1801.

Small epiphytic ferns. **Rhizome** short, creeping or suberect. **Lamina** simple, entire or crenate to shallowly lobed; vein simple or forked. **Sori** single row along both sides of midrib, round or elliptic.

Grammitis dorsipila (H. Christ) C. Chr. & Tardieu, Not, Syst. 8: 179. 1939; Devol and Kuo, Fl. Taiwan vol 1. 2 nd ed. 222. 1980; Tagawa & K. Iwats., Fl. Thailand 3(4): 582. 1989.- *Polypodium dosipilum* H. Christ in Warb., Monsunia 1: 59. 1900.

Rhizome short, ascending, slender, up to 4 mm diam., bearing several fronds in tuft, densely scaly; scale lanceolate, acute at apex, about 2 by 0.5 mm, entire Mé mbranous, pale brown. **Stipes** short, castaneous to dark purplish, up to 1-1.5 cm long or hardly distinct from the base of fronds, winged, hairy with shining brown setose patent hairs about 1 mm in length. **Lamina** simple, linear, moderate acute at apex, attenuate-cuneate at base, entire or slightly waved at margin, 3-10 cm by 2-6 mm, veins hardly visible, coarsely leathery, shining brown hair throughout. **Sori** dorsal, costal to submarginal, round or oblong, not fusing to the neighbourings, up to 2 mm diam. **Fig. 6.148**

Thailand.- CENTRAL: Nakhon Nayok (Khao Yai); SOUTH-WESTERN: Prachuap Khiri Khan (Khao Luang); PENINSULAR: Phangnga (Khao Phota Luang Kaeo, Khao Katha Khwam).

Distribution.- S. Japan, Ryukyus, S. China (type) and Indochina.

Ecology.- On mossy tree-trunks in Hill evergreen forest at 1050 m altitudes.

Specimens examined.- BCU: Y. Yuyen 142; T. Boonkerd 356, 1499

Fig. 6.3. Huaiyang Waterfall National Park

Fig. 6.4. Huaiyang Waterfall, 120 m a.s.l.

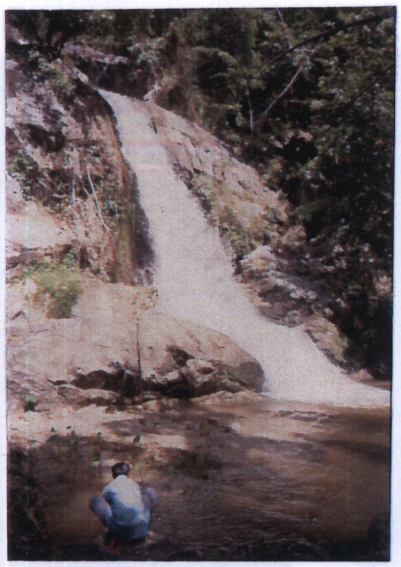


Fig. 6.5. Kha On Waterfall, 170 m a.s.l.

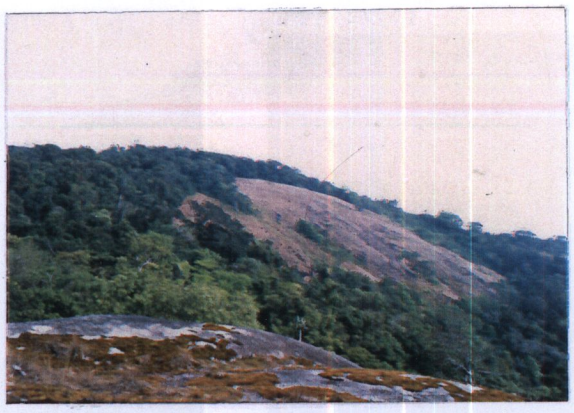


Fig. 6.6. Khao Luang Peak, 1,250 m a.s.l.

Fig. 6.7. Hill Evergreen Forest, 1,050 m a.s.l.

Fig. 6.8. Tropical Evergreen Forest, 800 m a.s.l.

Fig. 6.9. *Lycopodiella cernua* (L.) Pichi Serm.

Fig. 6.10. *Huperzia hamiltonii* (Spreng.) Trevis

Fig. 6.11. *Selaginella amblyphylla* Alston

Fig. 6.12. *Selaginella kurzii* Baker, sporophylls

Fig. 6.13. *Selaginella argentea* (Wall. ex Hook. & Grev.) Spring

Fig. 6.14. *Selaginella minutifolia* Spring

Fig. 6.15. *Selaginella kurzii* Baker

Fig. 6.16. *Selaginella delicatula* (Desv.ex Poir.) Alston

Fig. 6.17. *Selaginella roxburghii* (Hook. & Grev.) Spring

Fig. 6.18. *Selaginella ostenfeldii* Hieron

Fig. 6.19. *Selaginella vaginata* Spring

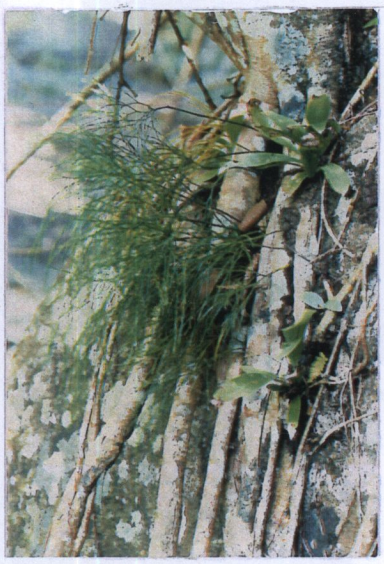


Fig. 6.20. *Psilotum nudum* (L.) Beauv.

Fig. 6.21. *Ophioglossum petiolatum* Hook.

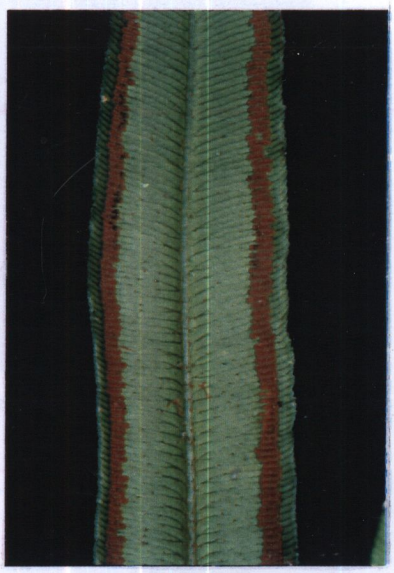


Fig. 6.22. *Angiopteris evecta* (G. Forst) Hoffm., sori

Fig. 6.23. *Angiopteris evecta* (G. Forst) Hoffm.

Fig. 6.24. *Crepidomanes bipunctatum* (Poir.) Copel.

Fig. 6.25. *Crepidomanes minutum* (Blume) K. Iwats.

Fig. 6.26. *Hymenophyllum barbatum* (Bosch) Baker

Fig. 6.27. *Hymenophyllum exsertum* Wall. ex Hook.

Fig. 6.28. *Crepidomanes megistostomum* (Copel.) Copel.

Fig. 6.29. *Crepidomanes parvifolium* (Baker) K. Iwats.

Fig. 6.30. *Dicranopteris linearis* (Burm. f.) Underw. var. *linearis*

Fig. 6.31. *Lygodium salicifolium* C. Presl

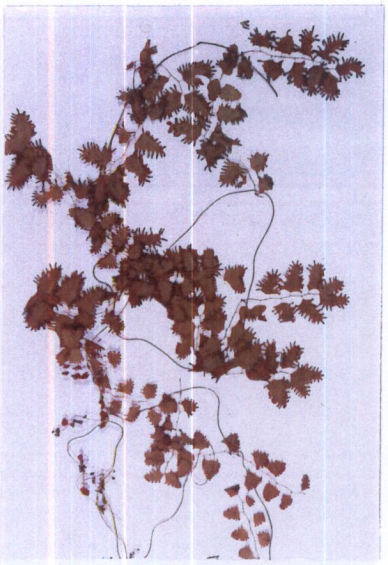


Fig. 6.32. *Lygodium microphyllum* (Cav.) R. Br.

Fig. 6.33. *Cibotium barometz* J. Sm., golden hairs on rhizome

Fig. 6.34. *Microlepia puberula* v. A. v. R.

Fig. 6.35. *Microlepia speluncae* (L.) T. Moore

Fig. 6.36. *Microlepia strigosa* (Thunb.) C. Presl

Fig. 6.37. *Lindsaea divergens* Hook. & Grev

Fig. 6.38. *Lindsaea ensifolia* Sw.

Fig. 6.39. *Sphenomeris chinensis* (L.) Maxon var. *divaricata* (H. Christ) K. U. Kramer

Fig. 6.40. *Cyathea borneensis* Copel

Fig. 6.41. *Cyathea latebrosa* (C. Presl) Copel.

Fig. 6.42. *Adiantum caudatum* L.

Fig. 6.43. *Adiantum philippinse* L.

Fig. 6.44. *Adiantum zollingeri* Mett. ex Kuhn

Fig. 6.45. *Hemionitis arifolia* (Burm. f.) T. Moore, fertile frond

Fig. 6.46. *Hemionitis arifolia* (Burm. f.) T. Moore

Fig. 6.47. *Doryopteris ludens* (Wall. ex Hook.) J. Sm

Fig. 6.48. *Notholaena velutina* Tardieu & C. Chr., fertile frond

Fig. 6.49. *Notholaena velutina* Tardieu & C. Chr.

Fig. 6.50. *Pityrogramma calomelanos* (L.) Link.

Fig. 6.51. *Ceratopteris thalictroides* (L.) Brongn.

Fig. 6.52. *Pteris longipinnula* Wall. ex J. Agardh

Fig. 6.53. *Pteris venusta* Kunze

Fig. 6.54. *Pteris biaurita* L.

Fig. 6.55. *Pteris cretica* L.

Fig. 6.56. *Stenochlaena palustris* (Burm. f.) Bedd.

Fig. 6.57. *Vittaria ensiformis* Sw.

Fig. 6.58. *Antrophyum callifolium* Blume

Fig. 6.59. *Vittaria amboinensis* Fée, sori

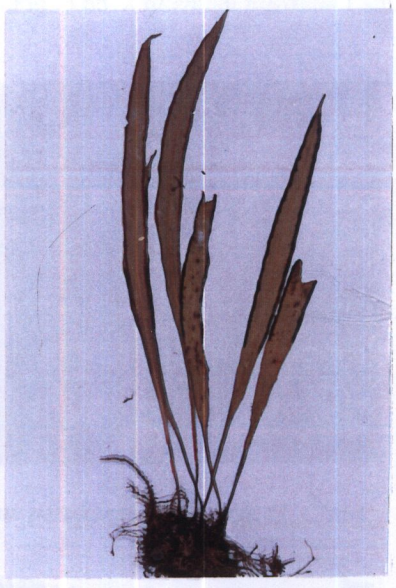


Fig. 6.60. *Vittaria amboinensis* Fé

Fig. 6.61. *Vittaria sikkimensis* Kuhn

Fig. 6.62. *Asplenium cheilosorum* Kunze ex Mett.

Fig. 6.63. *Asplenium cheilosorum* Kunze ex Mett., sori

Fig. 6.64. *Asplenium crinicaule* Hance

Fig. 6.65. *Asplenium falcatum* Lam.

Fig. 6.66. *Asplenium nidus* L. var. *nidus*

Fig. 6.67. *Asplenium perakense* Mathew & H. Christ

Fig. 6.68. *Asplenium confusum* Tardieu & Ching

Fig. 6.69. *Asplenium yoshinagae* Makino

Fig. 6.70. *Asplenium normale* D. Don

Fig. 6.71. *Asplenium scortechinii* Bedd.

Fig. 6.72. *Asplenium unilaterale* Lam.

Fig. 6.73. *Asplenium simonsianum* Hook.

Fig. 6.74. *Asplenium simonsianum* Hook., sori

Fig. 6.75. *Blechnum orientale* L.

Fig. 6.76. *Elaphoglossum subellipticum* Rosenst.

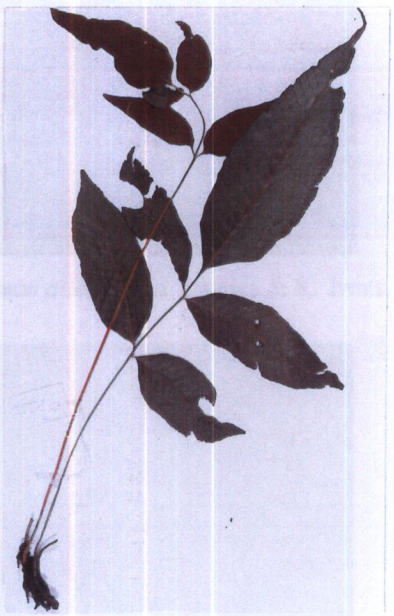


Fig. 6.77. *Bolbitis heteroclita* (C. Presl) Ching

Fig. 6.78. *Bolbitis appendiculata* (Willd) K. Iwats. subsp. *appendiculata*

Fig. 6.79. *Bolbitis sinensis* (Baker) K. Iwats var. *sinensis*

Fig. 6.80. *Bolbitis virens* (Wall. ex Hook. & Grev.) Schott var. *compacta* Hennipman

Fig. 6.81. *Dryopteris sparsa* (D. Don) Kuntze.

Fig. 6.82. *Heterogonium gurupahense* (C. Chr.) Holttum

Fig. 6.83. *Polystichum attenuatum* Tagawa & K. Iwats.

Fig. 6.84. *Polystichum biaristatum* (Blume) T. Moore

Fig. 6.85. *Pteridrys syrmatica* (Willd.) C. Chr. & Ching

Fig. 6.86. *Tectaria griffithii* (Baker) C. Chr.

Fig. 6.87. *Tectaria polymorpha* (Wall. ex Hook.) Copel.

Fig. 6.88. *Tectaria impressa* (Fée) Holttum

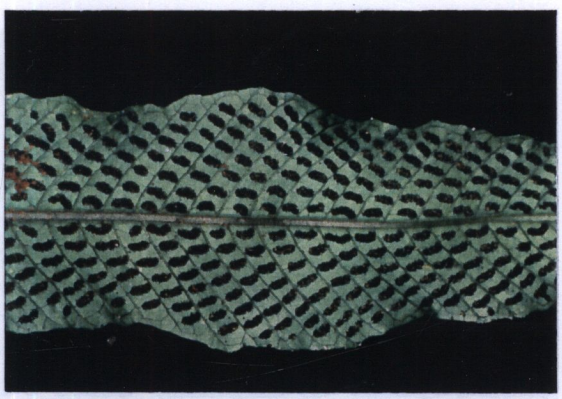


Fig. 6.89. *Thelypteris triphylla* (Sw.) K.Iwats.var. *triphylla*, sori

Fig. 6.90. *Thelypteris triphylla* (Sw.) K Iwats.var. *triphylla*

Fig. 6.91. *Thelypteris aspera* (C. Presl) K. Iwats

Fig. 6.92. *Thelypteris hirsutipes* (Clarke) Ching

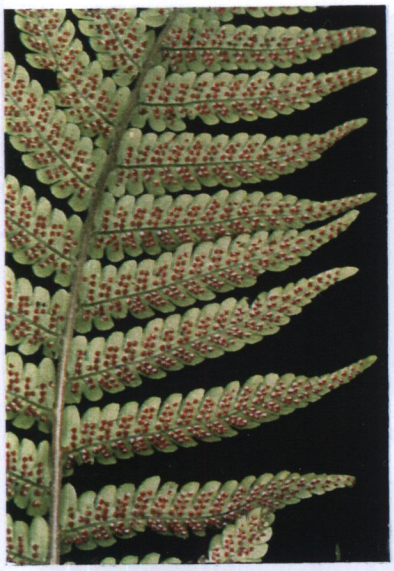


Fig. 6.93. *Thelypteris hirsutipes* (Clarke) Ching, fertile frond

Fig. 6.94. *Thelypteris dentata* (Forssk.) St. John

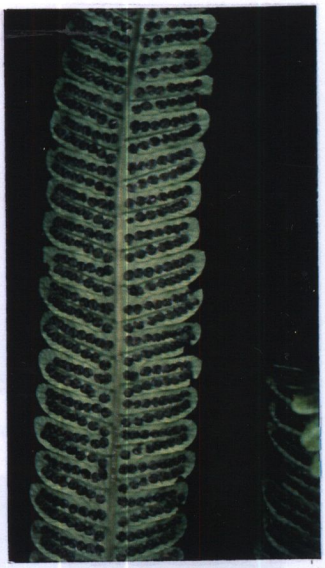


Fig. 6.95. *Thelypteris hirtisora* (C. Chr.) K. Iwats.

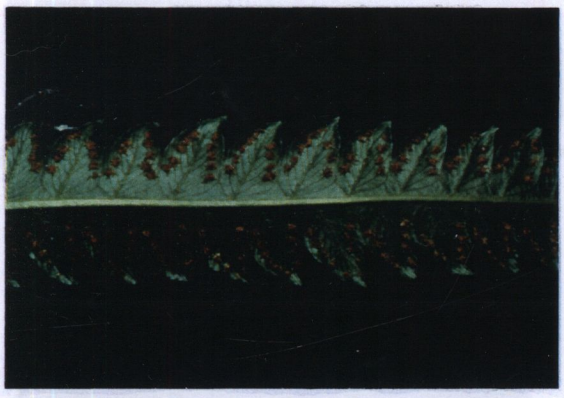


Fig. 6.96. *Thelypteris interrupta* (Willd.) K. Iwats.

Fig. 6.97. *Thelypteris papilio* (Hope) K. Iwats.

Fig. 6.98. *Thelypteris parasitica* (L.) Fosberg

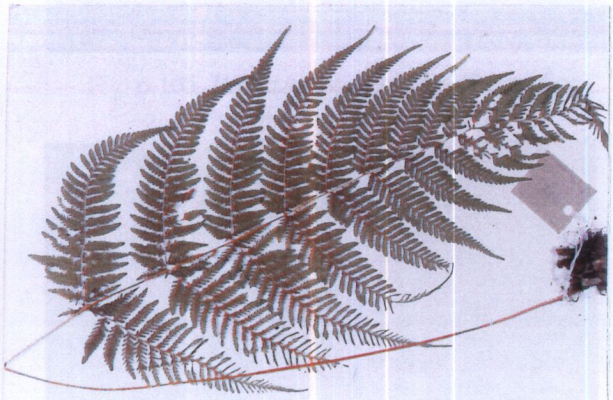


Fig. 6.99. *Thelypteris torresiana* (Gaud.) Alston

Fig. 6.100. *Thelypterris truncata* (Poir.) K. Iwats.

Fig. 6.101. *Diplazium bantamense* Blume

Fig. 6.102. *Diplazium crenatoserratum* (Blume) T. Moore

Fig. 6.103. *Diplazium dilatatum* Blume

Fig. 6.104. *Diplazium donianum* (Mett.) Tardieu

Fig. 6.105. *Diplazium esculentum* (Retz.) Sw

Fig. 6.106. *Diplazium petri* Tardieu

Fig. 6.107. *Diplazium simplicivenium* Holttum

Fig. 6.108. *Diplazium simplicivenium* Holttum, sori

Fig. 6.109. *Diplazium* sp.

Fig. 6.110. *Davallia aenticulata* (Burm. f.) Mett. ex Kuhn

Fig. 6.111. *Davallia solida* (G. Forst.) Sw

Fig. 6.112. *Humata repens* (L. f.) J. Small ex Diels

Fig. 6.113. *Leucostegia immersa* C. Presl

Fig. 6.114. *Leucostegia immersa* C. Presl, sori

Fig. 6.115. *Nephrolepis biserrata* (Sw.) Schott

Fig. 6.116. *Nephrolepis hirsutula* (G. Forst.) C. Presl

Fig. 6.117. *Oleandra musifolia* (Blume) C. Presl

Fig. 6.118. *Colysis pedunculata* (Hook. & Grev.) Ching

Fig. 6.119. *Belvisia revoluta* (Blume) Copel., fertile frond

Fig. 6.120. *Belvisia revoluta* (Blume) Copel

Fig. 6.121. *Belvisia mucronata* (Fée) Copel

Fig. 6.122. *Aglaomorpha coronans* (Wall. ex Mett.) Copel.

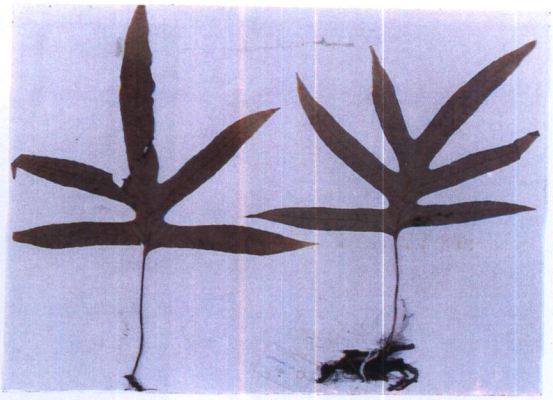


Fig. 6.123. *Crypsinus oxylobus* (Wall. ex Kunze) Sledge

Fig. 6.124. *Drynaria bonii* H. Christ

Fig. 6.125. *Drynaria quercifolia* (L.) J. Sm.

Fig. 6.126. *Drynaria rigidula* (Sw.) Bedd.

Fig. 6.127. *Lemmaphyllum carnosum* (J. Sm. ex Hook.) C. Presl, fertile fronds

Fig. 6.128. *Lemmaphyllum carnosum* (J. Sm. ex Hook.) C. Presl

Fig. 6.129. *Lepisorus scolopendrium* (Buch.-Ham ex D. Don) Mehra & Bir

Fig. 6.130. *Neocheiropteris normalis* (D. Don) Tagawa

Fig. 6.131. *Platycerium holttumii* Jonch. & Hennipman

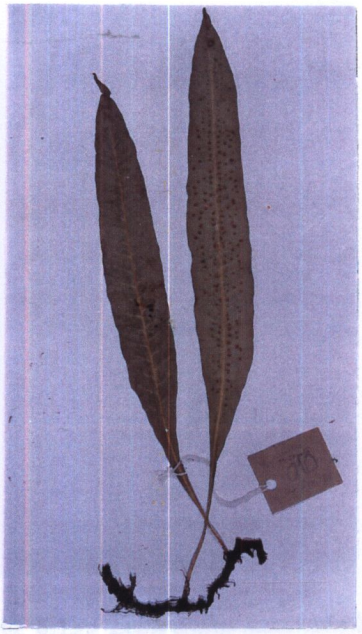


Fig. 6.132. *Microsorum zipelii* (Blume) Ching

Fig. 6.133. *Microsorum pteropus* (Blume) Copel.

Fig. 6.134. *Microsorum punctatum* (L.) Copel

Fig. 6.135. *Microsorum heterocarpum* (Blume) Ching

Fig. 6.136. *Microsorum nigrescencs* (Blume) Copel.

Fig. 6.137. *Microsorum dilatatum* (Bedd.) Sledge

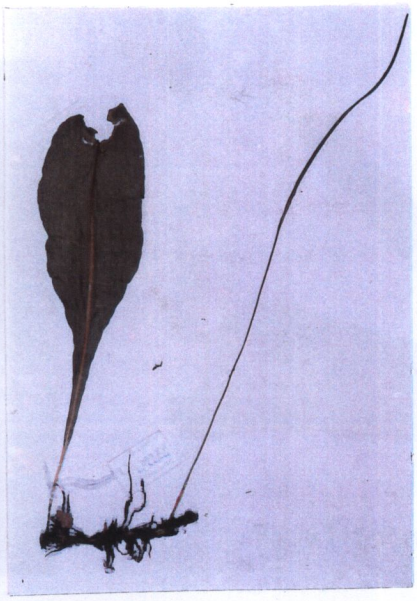


Fig. 6.138. *Leptochilus decurrens* Blume

Fig. 6.139. *Leptochilus macrophyllus* (Blume) Noot var. *macrophyllus*

Fig. 6.140. *Loxogramme avenia* (Blume) C. Presl

Fig. 6.141. *Loxogramme avenia* (Blume) C. Presl, sori

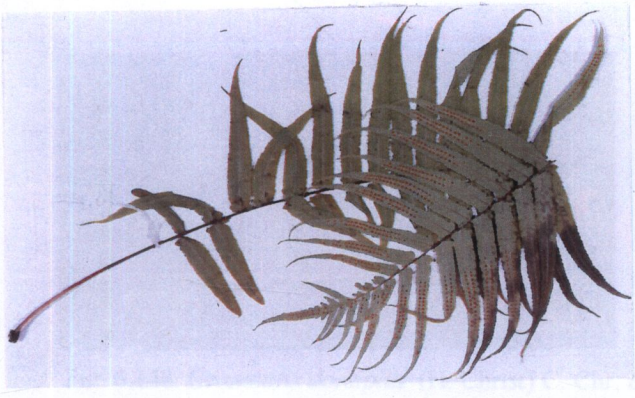


Fig. 6.142. *Polypodium subauriculatum* Blume

Fig. 6.143. *Pyrrosia nuda* (Giesenh) Ching

Fig. 6.144. *Pyrrosia adnascens* (Sw.) Ching

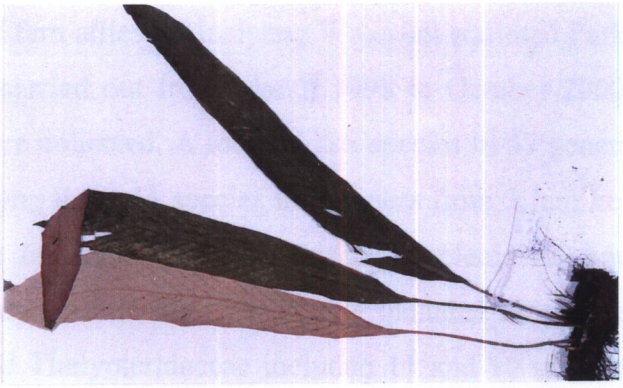


Fig. 6.145. *Pyrrosia stigmosa* (Sw.) Ching

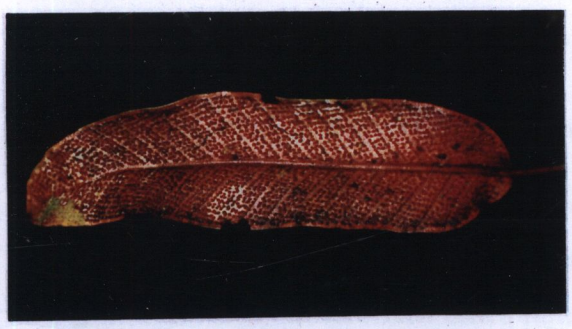


Fig. 6.146. *Pyrrosia eberhardtii* (H. Christ) Ching

Fig. 6.147. *Ctenopteris mollicoma* (Nees & Blume) Kunze

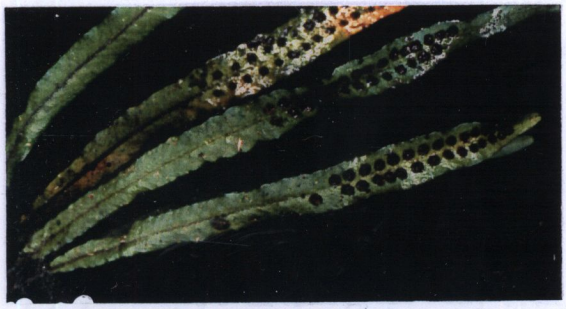


Fig. 6.148. *Grammitis dorsipila* (H. Christ) C. Chr. & Tardieu

CHAPTER VI

CONCLUSION AND DISCUSION

Taxonomic survey of ferns and fern allies at Huaiyang Waterfall National Park, Prachaup Khiri Khan Province, was carried out from March 1998 to October 2000. Two hundreds and four specimens were collected. A total of 126 species in 57 genera from 26 families were identified. Among these 11 species in 4 genera from 3 families are fern allies. Three families of true fern namely Polypodiaceae, Aspleniaceae and Thelypteridaceae are among the common families. Polypodiaceae included 26 species in 14 genera. Whilst Aspleniaceae and Thelypteridaceae included 11 and 10 species, respectively; but from each single genus. Among 126 species, there are 53 species of terrestrial plants, 17 species of epiphytes, 19 species of lithophytes and 1 species of aquatic plant. However, 36 species thrive in more than two habitats. It can be concluded that 22 species are found in Mixed Deciduous Forest. While 14 species occur in Dry Evergreen Forest. Whilst 20 species are found in Tropical Evergreen Forest, and 34 species grow naturally in Hill Evergreen Forest. Moreover 32 species may be found in more than two vegetations.

1. Diversity of ferns and fern allies and vegetation

Huaiyang Waterfall National Park composed of four vegetations namely Mixed Deciduous Forest, Dry Evergreen Forest, Tropical Evergreen Forest and Hill Evergreen Forest. Fern and fern allies naturally dispersed in all of these vegetations, but in rather different numbers of species.

1.1 Mixed Deciduous Forest (MDF)

This type of forest occupies about 31% of the national park area. It is a Dry Upper Mixed Deciduous Forest at the elevation of 500-800 m, low relative humidity, thin layer of soil on the base rock. Most trees are dwarfed and bamboos are frequently found throughout (สุพจน์ พริ้งเพริศ, 2543). So far, 37 species of ferns and fern allies were observed in this forest type, but 12 species can also be found in the other forest-types. Most of them are terrestrial plants and lithophytes, with only a few species of epiphytes. Epiphytes are perpetually seen on the lower part of tree-trunks, probably due to low relative humidity on upper portion of trees. In addition, an aquatic species, *Ceratopteris thalictroides* (L.) Brongn., was found in this forest. Generally, ferns and

fern allies usually grow in shady places, along stream bank or at a moist spot. The common species included, *Adiantum caudatum* L., this maiden-hair fern usually grow on dry mountain slopes. Whereas *Doryopteris ludens* (Wall. ex Hook.) J. Sm., is found in both moist and dry places. While *Thelypteris interrupta* (Willd.) K. Iwats. is found in rather open area along stream and *Microsorum pteropus* (Blume) Copel., is a rheophyte often found on the moist area near streams or waterfalls. Some epiphytic ferns in this forest showed some drought resistance or drought avoidance in some degrees. For example, *Davallia denticulata* Blume, *D. solida* (G. Forst.) Sw., *Drynaria bonii* H. Christ, *D. quercifolia* (L.) J. Sm. and *D. rigidula* (Sw.) Bedd. shed their fronds or parts of laminas during dry season, only rhizomes are found on rocks or on tree trunks. Rhizomes of these ferns are succulent, and covered with dense scales, these characters protected the plant from desiccation and survived over the dry season. Some terrestrial species, for example *Selaginella ostenfeldii* Hieron, *Ophioglossum petiolatum* Hook., *Notholaena velutina* Tardieu & C. Chr. and *Pityrogramma calomelanos* (L.) Link. shed their fronds or fronds were dried out during dry months, however rhizome still remained underneath the soil and these ferns became dormancy. Shortly after some rains new leaves of these ferns will be produced. Some fern species reduced transpiration by decreasing their leaves surface from dry atmosphere by curling their fronds, such as *Adiantum caudatum* L., *A. zollingeri* Mett. ex Kuhn and *Pyrrosia adnascens* (Sw.) Ching.

1.2 Dry Evergreen Forest (DEF)

Dry Evergreen forest at Huaiyang Waterfall National Park was about 46% of the total area. Plants grew in this forest were both deciduous and evergreen trees, so the canopy was still green all the year round. In this forest, soil layer is deep and composed mainly of moist sandy loam (สุพจน์ พริ้งเพริศ, 2543). The elevation ranges from 100 to 800 m. Thirty five species of ferns and fern allies were found in this forest type. It was found that 14 species was restricted only in this forest type and 12 species were found both in Mixed Deciduous Forest and Dry Evergreen Forest. Generally, ferns and fern allies grew in shady areas and nearby streams. Lithophytes and terrestrial ferns were approximately the same amount. Relative air humidity is generally higher than Mixed Deciduous Forest. Accordingly, numbers of epiphytes and lithophytes were higher than Mixed Deciduous Forest. For examples, *Crepidomanes megistostomum* L., was found in shady and moist cliffs nearby streams. While

Cyathea borneensis Copel, was found only one plant by a stream. *Antrophyum callifolium* Blume usually grows on moist rocks or tree trunks. Whereas *Pteridry syrmatica* (Willd.) C. Chr. & Ching can be found on shady hill slopes. In this type of forest *Platycerium holttumii* Jonch. & Hennipman is one of a large epiphyte, this species usually grows on high branches of trees. Whilst *Vittaria ensifomis* Sw., is a small plant, usually occurs on a shady spot of tree trunk or grows on a decomposed log. Nearby this area, a medium-size fern, *Pyrrosia stigmosa* (Sw.) Ching was found on humus rich rocks.

1.3 Tropical Evergreen Forest (TEF)

This forest is approximately 20% of the national park whole area. This forest type is composed medium-to-tall trees which remain almost green during the dry season, and has a closed to slightly open canopy. There are a large number of ground covers. They are shade loving plants, for example the zingiberaceous species. Palms also can be found else where. By and large relative air humidity is rather high, soil layers are deep with high soil humidity (สุพจน์ พริ้งเพริศ, 2543) The elevation ranges from 800 to 1,000 m. Thirty nine species of fern and fern allies were found, and 21 species can be found only in this forest type. Though Tropical Evergreen Forest is close to the Dry Evergreen Forest, only 2 species, i.e. *Diplazium donianum* (Mett.) Tardieu and *Diplazium simplicivenium* Holttum were common species. In contrast 9 species of fern and fern allies were commonly found in both Tropical Evergreen Forest and Hill Evergreen Forest. However, 20 species of ferns and fern allies that was found in Tropical Evergreen Forest could not be found in Hill Evergreen Forest, this result suggested that the exploration should be done over the whole area of each forest type. In addition, the climatic condition of the Hill Evergreen Forest, which has a fluctuation of temperatures during night and day times, and high light intensity during day time may not suitable for some ferns which are used to some stable conditions of the Tropical Evergreen Forest. Examples of terrestrial ferns are *Cibotium barometz* J. Sm., *Pteris cretica* L, *Bolbitis heteroclita* (C. Presl) Ching, *Tectaria polymorpha* (Wall. ex Hook.) Copel., *Diplazium crenatoserratum* (Blume)T.Moore, *Leptochilus macrophyllus* (Blume) Noot var. *macrophyllus.* Among these, *Cibotium barometz* J. Sm. is a big fern, it has many big bipinnate fronds, usually 3-4 metres in length. Whereas the other species are medium-size ferns, usually occupy moist and shady

places near by streams. However, *Leptochilus macrophyllus* (Blume) Noot var. *macrophyllus* usually grows on buttress or base of tree trunk.

1.4 Hill Evergreen Forest (HEF)

This forest type is about 2% of the whole national park area. It is a primary forest near the summit of Khao Luang. The elevation ranges from 1,000 to 1,250 m. Main canopy trees are broad-leaves members of Fagaceae, Lauraceae, Theaceae and Dipterocarpaceae. Tree trunk is usually covered with bryophytes, but filmy ferns is uncommon. In general, rainfalls can be observed from March to November. Soil in this forest is rather deep, rich in humus and high humidity (สุพจน์ พริ้งเพริศ, 2543). Hill Evergreen Forest has the highest diversity of ferns and fern allies. In this study fifty five species were found as terrestrial plants, lithophytes and epiphytes on tree trunk or branches. It was found that 36 species of ferns and fern allies are true mountainous plants. Since they are confined to Hill Evergreen Forest. The high relative air humidity in this forest is probably resulted in high numbers of species in lithophytes and epiphytes. In open grasslands, *Lycopodiella cernua* (L.) Phichi Serm., is a common species. While *Asplenium perakense* B. Mathew & H. Christ, *Elaphoglossum subellipticum* Rosent., *Huperzia hamiltonii* (Spreng.) Trevis. and *Lepisorus scolopendrium* (Buch.-Ham. ex D. Don) Mehra & Bir were found as epiphytes. The common terrestrial species included *Microlepia puberula* v. A. v. R. and *Polystichum attenuatum* Tagawa & K. Iwats. Lithophytes are common on moist rocks nearby streams, for example *Asplenium unilaterale* Lam. In addition, *Oleandra musifolia* (Blume) C. Presl occurs on tree trunk or on dry cliffs. All of the species mentioned above are examples of ferns and fern allies which are restricted in Hill Evergreen Forest.

It was found that 6 species namely *Crepidomanes bipunctatum* (Poir.) Copel; *Asplenium confusum* Tardieu & Ching; *A. crinicaule* Hance; *A. nidus* L. var. *nidus*; *Polypodium subauriculatum* Blume and *Pteris biaurita* L. can be found in more than 3 forest types. This finding is probably due to their preferences for ecological niche are broad, resulted in their present wide distribution at Huaiyang Waterfall National Park as well as in Thailand.

In short, Hill Evergreen Forest has the highest diversity of ferns and fern allies, despite its small proportion (2%). Since this forest type can be found only nearby the summit of Khao Luang. The high diversity may be due to the suitable ecological

factors for ferns and fern allies in this forest type. Moreover, the difficulty to access to this remote site may be more or less protected this forest type from human disturbance.

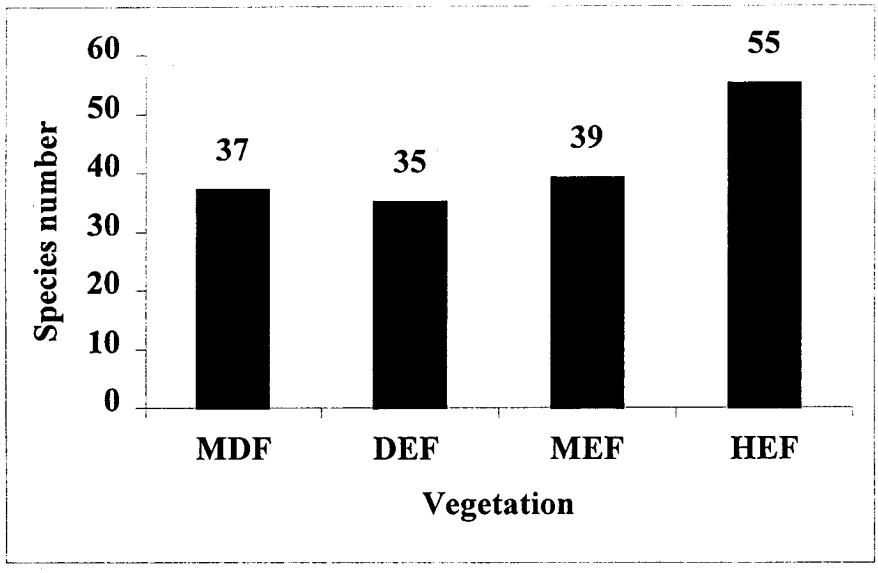


Figure 6.1 Diversity of ferns and fern allies in each vegetation.

2. Habitat and Diversity of Ferns and Fern Allies

Generally, individual species of ferns and fern allies has its own preference for habitat to complete its life cycle. At Huaiyang Waterfall National Park there occurs 4 different habitats. Nonetheless, some species can be found in more than one habitat.

2.1 Terrestrial plants

It was found that 53 species of ferns and fern allies were terrestrial plants. This type of habitat included shady areas, stream banks, mountain slopes or open grasslands. Plants grew in this habitat usually have medium to large sizes rhizomes. Terrestrial pteridophytes can be found in all forest types. It is found that in somewhat dry forests, numbers of terrestrial species usually higher than lithophytes and epiphytes, for example in Mixed Deciduous Forest and Dry Evergreen Forest. In this types of forest, humidity in soils is usually higher than on rocks or tree trunks and it is suitable enough for terrestrial plants to complete their life cycle, whilst only small numbers of drought-resistance or drought- avoidance lithophytes and epiphytes can thrive in such dry habitats. *Angiopteris evecta* (G. Fosrt) Hoffm. is an example of large terrestrial ferns, this plant usually occurs nearby moist spots, such as spring, stream banks. *Microlepia strigosa* (Thunb.) C. Presl, and *Cibotium barometz* J. Sm.,

usually grow on shady hill slopes. *Blechnum oreintale* L., is a shade plant or sometimes can be found on exposed hill slopes. While *Heterogonium gurupahense* (C. Chr.) Holttum and *Thelypteris truncata* (Poir.) K. Iwats are usually found in shady areas along forest tracts or by stream banks. Whilst *Diplazium esculentum* (Retz.) Sw. frequently occurs along stream banks in exposed places at the forest margin. On mountain slopes or by stream bank there is a common terrestrial species, *Diplazium donianum* Blume.

2.2 Lithophytes

Only 19 species of lithophytes were observed. Ferns and fern allies can be found on bare or humus-rich rocks in shady or exposed places. Some species thrive in rock crevices or cliffs. Some ferns grow on muddy rocks in the streams. Moisture is a limiting factor for this lithophyte. Lithophytes are usually found in high humidity area such as, stream banks, waterfalls in Tropical Evergreen Forest and Hill Evergreen Forest. In general, true lithophytes are often small to medium sizes. Rhizome is usually creeping and well attached to the rock surface. An example of lithophyte in streams is *Crepidomanes parvifolium* (Baker) K. Iwats. *Antrophyum callifolium* Blume grows on muddy rocks as well as on mossy tree-trunks in shady places. A true lithophytic fern, *Bolbitis appendiculata* (Willd) K. Iwats. subsp. *appendiculata*, usually found on a small rock covered with thin muddy layer. Whilst *Loxogramae avenia* (Blume) C. Presl grows on big rocks or cliffs at or near a waterfall. *Microsorum nigrescencs* (Blume) Copel. is also found on big rocks in the stream in the Dry Evergreen Forest. This fern may encounter dry condition during dry season after water in the stream is depleted. A number of *Drynaria* spp. have succulent long creeping rhizomes. These ferns thrived on rocks in exposed places or on tree-trunks. They survived over dry season by having water-storage in a succulent rhizome as well as reducing the surface of their fronds from transpiration by shedding their fronds or part of their laminas.

2.3 Epiphytes

Merely 17 species of epiphytes are discovered at Huaiyang Waterfall National Park. Of these, twelve species occurs in Hill Evergreen Forest. Generally, epiphyte usually grows on tree-trunks or branches in high relative air humidity. Examples of epiphytes are *Lycopodium hamiltonii* Spr., *Hymenophylum barbatum* (Bosch) Baker, *H. exsertum* Wall. ex Hook., *Vittaria amboinensis* Fée, *Elaphoglossum subellipticum* Rosent., *Belvisia mucronata* (Fée) Copel., *Colysis pedunculata* (Hook. &

Grev.) Ching, *Crypsinus oxylobus* (Wall. ex Khunze) Sledge and *Grammitis dorsipila* (H. Christ) C. Chr. & Tadieu.

2.4 Aquatic plant

Only one species of aquatic fern, i.e. *Ceratopteris thalictroides* (L.) Brongn., was found in this study. It is an immersed water-fern found only in a streamlet near the head office of the national park.

As mentioned earlier some plants can flourish in more than one habitats. For example, terrestrial plants can be found as lithophytes. Fourteen species are detected, examples of these plants are *Selaginella argentea* (Wall. ex Hook. & Grev.) Spring, *Notholaena velutina* Tardieu & C. Chr., *Asplenium crinicaule* Hance, *Asplenium unilaterale* Lam. *Thelypteris hirsutipes* (Clarke) Ching, *Microsorum zipelii* (Blume) Ching.

Twenty two species of pteridophytes can be found as lithophytes or epiphytes. Small root system and wide-creeping rhizomes are characteristic of these plant Examples are *Crepidomanes bipunctatum* (Poir.) Copel. *Asplenium confusum* Tardieu & Ching, *Asplenium falcatum* Lam., *Asplenium perakense* Mathew & H. Christ, *Asplenium yoshinakae* Makino, *Asplenium scortechinii* Bedd. However, there are also plants with large creeping rhizomes members of the families Polypodiaceae and Davalliaceae. For example, *Davalia denticulata* (Burm. f.) Mett. ex Kuhn, *Davallia solida* (G. Forst.) Sw., *Humata repens* (L. f.) J. Small ex Diels, *Drynaria bonii* H. Christ, *Drynaria rigidula* (Sw.) Bedd., *Lemmaphyllum carnosum* (J. Sm. ex Hook.) C. Presl, *Polypodium subauriculatum* Blume, *Pyrrosia adnascens* (Sw.) Ching, *P. eberhardtii* (H. Christ) Ching, *Asplenium nidus* L. var. *nidus, Bolbitis sinensis* (Baker) K. Iwats. var. *sinensis, Aglaomorpha coronans* (Wall. ex Mett.) Copel. and *Oleandra musifolia* (Blume) C. Presl.

3. Elevation, Distribution and Diversity of Ferns and Fern allies

The elevation of Huaiyang Waterfall National Park ranges from 100–1,250 m. It was found that the number of species at the elevation of 100-800 m was the highest, i.e. 60 species. There were 39 species were found at the elevation of 800-1,000 m. and 55 species at the elevation of 1,000-1,250 m. However, it was found that the area at the elevation of 100-800 m is about 77% of the whole area and also composed of two forest types:- Mixed Deciduous and Dry Evergreen Forest. It is no doubt that number of species of ferns and fern allies is high and related to the covered area between this

elevation. In comparison to the smaller number of species at the elevation of 800-1,000 m and 1,000-1,250 m. However, the high number of species was observed between the elevation of 1,000-1,250 m which covered only 2% of the whole national park area. Hence, the ecological factors at high elevation of Hill Evergreen Forest are suitable for growth and development of these pteridophytes.

From Figure 6.2 it was found that 55 species of ferns and fern allies were observed at the elevation of 1,000-1,250 m. This elevation was the most suitable level for growth and development of ferns and fern allies. The second suitable level was at the elevation of 800-899 m, 28 species were noted, Tropical Evergreen Forest is a forest type at this elevation. It was found that 22-24 species were found at the elevation of 100-499 m. Mixed Deciduous Forest and Dry evergreen Forest are the two forest types at these elevations. At the elevation of 500-799 m only small numbers of ferns and fern allies were observed, probably due to the drier habitats of ridges at these levels.

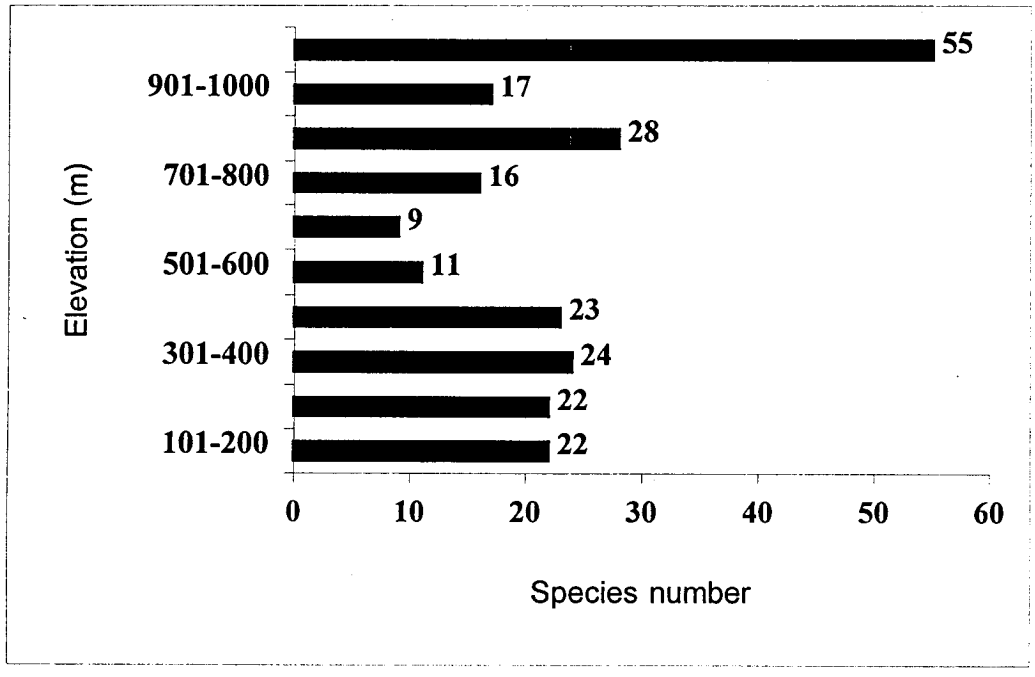


Figure 6.2 Diversity of ferns and fern allies in relation to elevations

4. Uncommon Fern Species

In this study 12 species of ferns were found with only 1-2 individuals during the surveys. They are listed below.

1. *Belvisia mucronata* (Fée) Copel.
2. *Ceratopteris thalictroides* (L.) Brongn.
3. *Cyathea borneensis* Copel.
4. *Cyathea latebrosa* (C. Presl) Copel.
5. *Grammitis dorsipila* (H. Christ) C. Chr. & Tardieu
6. *Hemionitis arifolia* (Burm. f.) T. Moore
7. *Hymenophyllum barbatum* (Bosch) Baker
8. *Hymenophyllum exsertum* Wall. ex Hook.
9. *Lindsaea divergens* Hook. & Grev.
10. *Pteris longipinnula* Wall. ex J. Agardh
11. *Pyrrosia nuda* (Giesenh) Ching
12. *Tectaria griffithii* (Baker) C. Chr.

Of the twelve uncommon species, *Lindsaea divergens* Hook. & Grev., found only once, growing in rock crevices. This plant is a member of Malesian element (Tagawa and Iwatsuki, 1985), it is never been recorded above Songkhla Province (Tagawa and Iwatsuki, 1985). So Huaiyang Waterfall National Park will be the present northernmost limit station for this fern species. There were some tiny epiphytes namely *Grammitis dorsipila* (H. Christ) C. Chr. & Tardieu; *Hymenophyllum barbatum* (Bosch) Baker and *Hymenophyllum exsertum* Wall. ex Hook. The minute size of these ferns may be in part made it difficult to observe. However, it was noted in Flora of Thailand that *Grammitis dorsipila* (H. Christ) C. Chr. & Tardieu was a rare species in Thailand (Tagawa and Iwatsuki, 1989). Moreover, *Hymenophyllum barbatum* (Bosch) Baker and *Grammitis dorsipila* (H. Christ) C. Chr. & Tardieu, used to be collected from Khao Luang, Prachaup Khiri Khan Province as reported in Flora of Thailand (Tagawa and Iwatsuki, 1979-1989). In the case of an aquatic fern, *Ceratopteris thalictroides* (L.) Brongn., only one plant was observed in this study. This species usually occupies the exposed area of waterway, but this type of microhabitat did not present at the site where this species was observed. However, It is noted that this species is becoming rarer in the areas where herbicides are used (Tagawa and Iwatsuki,

1985). The low number of individuals in some species listed above may be due to the survey could not be performed throughout the whole area of the national park. However, measures for protection and conservation for the protected areas of Huaiyang Waterfall National Park should be carried out tightly.

5. Endemic Species

From the literature surveys and the result from this study can be concluded that two endemic species to Thailand also occur in this studied area.

5.1 *Crepidomanes megistostomum* (Copel.) Copel., a lithophyte grows in Mixed Deciduous Forest at the elevation of 70 m. It was reported that this species used to be found in Phitsanulok (Thung Salaeng Luang) and Phangnga (Tagawa and Iwatsuki, 1979).

5.2 *Polystichum attenuatum* Tagawa & K. Iwats., a terrestrial fern occurs densely in Hill Evergreen Forest at the elevation of 1,050 m. It was report that this species can be found in northern, north-eastern and eastern Thailand (Tagawa and Iwatsuki, 1988).

6. Ferns and Fern allies of Prachaup Khiri Khan and Western Region

In this study, a total of 126 species of ferns and fern allies were identified within Huaiyang Waterfall National Park. Of these 126 species, 64 species have never been recorded in the western Thailand before. In addition, 100 species were reported for the first time in Prachaup Khiri Khan Province. Nineteen species of ferns and fern allies were collected from Huaiyang Waterfall National Park as were noted in Flora of Thailand (Tagawa and Iwatsuki, 1979-1989). However, in this survey only 14 species were found as listed below.

1. *Asplenium crinicaule* Hance
2. *Bolbitis heteroclita* (C. Presl) Ching
3. *Crepidomanes minutum* (Blume) K. Iwats.
4. *Drynaria bonii* H. Christ
5. *Drynaria quercifolia* (L.) J. Sm.
6. *Grammitis dorsipila* (H. Christ) C. Chr. & Tardieu
7. *Hymenophyllum barbatum* (Bosch) Baker

8. *Humata repens* (L. f.) J. Small ex Diels
9. *Microsorum pteropus* (Blume) Copel.
10. *Notholaena velutina* Tardieu & C. Chr.
11. *Psilotum nudum* (L.) Beauv.
12. *Pteridrys syrmatica* (Willd.) C. Chr. & Ching
13. *Pyrrosia adnascens* (Sw.) Ching
14. *Pyrrosia stigmosa* (Sw.) Ching

From these 14 species, *Notholaena velutina* Tardieu & C. Chr., was found only at Hua Hin and Huaiyang Waterfall National Park in Prachaup Khiri Khan Province (Tagawa and Iwatsuki, 1985). At Huaiyang Waterfall National Park this species is found in abundance in rock crevices in Mixed Deciduous Forest. Five species namely *Crepidomanes latealatum* (van den Bosch) Copel., *Ctenitis manilensis* (Presl) Holttum, *Oleandra pistillaris* (Sw.) C. Chr., *Prosaptia khasyana* (Hook.) C. Chr. & Tardieu and *Pyrrosia longifolia* (Brum. f.) Mort. could not be found from this survey. Though collections of ferns and ferns allies were made nearly every months from March 1998 to October 2000. However, the surveys could not be made to cover the whole area of the national park.

7. Rare Species

From the literature reviews and the results from this study can be concluded that two rare species of ferns were found in Huaiyang Waterfall National Park. The first one, if correctly identified is *Asplenium simonsianum* Hook. This is an epiphytic fern occurs in Mixed Deciduous Forest or Moist Evergreen Forest at the elevation of 300-800 m. This species is a member of the Indo-Burmese element (Tagawa and Iwatsuki, 1985), it was only collected from Tak Province of lower northern Thailand. So far its known distribution was exclusively in Assam, Northeast India where the type specimen was collected. Voucher specimens of this species could not be found either at The Professor Kasin Suvatabandu Herbarium (BCU) or The Bangkok Herbarium (BKF). The other species *Lindsaea divergens* Hook. & Grev. From its present distribution was a member of Malesian element (Tagawa and Iwatsuki, 1985). It was collected only from Songkhla Province and voucher specimens could not be found either at BCU or BKF. Nonetheless geographical distribution of this species was more expanded in the Malay Peninsula.

8. Record of New Locality

It was found that 9 species occur in Huaiyang Waterfall National Park are worth to note for their geographical distribution.

8.1 The Malesian element

Plant species members of Malesian element are known from their limited distribution extending from Malay Archipelago and Malay Islands to the Isthmus of Kra, in Ranong Province, Thailand (Boonkerd, 1996). According to the distribution noted in Flora of Thailand, Vol. 3 (Tagawa and Iwatsuki, 1979-1989), the following species should be noted as members of Malesian element.

Asplenium perakense Mathew & H. Christ is a lithophyte or epiphyte. It was found in Hill Evergreen Forest at the elevation of 1,000-1,700 m of Khao Luang, in Nakhon Si Thammarat Province. In this studied area, it was found commonly in Hill Evergreen Forest at the elevation of 1,050 m.

Ctenopteris mollicoma (Nees & Blume) Kunze was found at Khao Luang in Hill Evergreen Forest, in Nakhon Si Thammarat and Yala Province. It is a lithophyte or epiphyte in Hill Evergreen Forest at the elevation of 1,050 m in this studied site.

Diplazium bantamense Blume was found in many provinces of peninsular Thailand, e.g. Surat Thani, Nakhon Si Thammarat, Trang and Yala. In this studied area, it occurs commonly near stream bank at the elevation of 800 m in Moist Evergreen Forest.

Diplazium crenatoserratum (Blume) T. Moore was found in Surat Thani, Nakhon Si Thammarat, Satun and Yala Province. In this studied site, it occurs commonly near stream at the elevation of 800 m in Tropical Evergreen Forest.

Leptochilus macrophyllus (Blume) Noot var. *macrophyllus* was found in Narathiwat, Yala and Pattani Province. This species is uncommon in this studied site. It grows on rock or tree-trunk at 800 m in Tropical Evergreen Forest.

Lindsaea divergens Hook. & Grev. was found at Khao Khaeo in Songkhla Province. It is uncommon species in this studied site, grows on rock crevices at 500 m in Mixed Deciduous Forest.

Microsorum heterocarpum (Blume) Ching was found at Khao Chong in Trang Province. In this studied site, it was commonly found on rocks near stream banks or on rocks in streamlets at the elevation of 800 m in Tropical Evergreen Forest.

8.2 The Indo-Burmese element

The Indo-Burmese element occupies the areas from the eastern Himalayas and Guinghai-Tibetan plateau and the subtropics of South China, the Ganges plain, eastern India, Bangladesh, Upper Myanmar and Thailand (Boonkerd, 1996). It was found that *Asplenium simonsianum* Hook. occurs in Assam, N.E. India. This species was found in Tak Province and was recorded as a southern limit of this species. The occurrence of this species at Huaiyang Waterfall National Park is still in agreement with the distribution of Indo-Burmese element. But the southernmost limit of this species will be at Prachuap Khiri Khan Province instead of Tak Province. It is commonly found as an epiphyte at the elevation of 300-800 m in Mixed Deciduous Forest and Tropical Evergreen Forest. This fern is also noted as a rare species in Thailand.

8.3 The Indo-Chinese element

The Indo-Chinese region covers the areas of Southern China and Indochina. According to distribution of *Diplazium petri* Tardieu in Flora of Thailand (Tagawa and Iwatsuki, 1979-1989). This species was a member of Indo-Chinese element. In Thailand, it was found in Chon Buri Province and in Nakhon Si Thammarat. So it was no longer member of the Indo-Chinese element. The presence of this species at Huaiyang Waterfall National Park confirmed the wide distribution of this species outside the boundary of Indo-Chinese region. It is found at the elevation of 1,050 m in Hill Evergreen Forest in this studied site.

Geographically speaking, Huaiyang National Park is in the boundary of the Indo-Burmese element, but however, seven species member of the Malesian-element flourish here. So, Prachaup Khiri Khan Province may be the northernmost limit of the Malesian element as well as the meeting point for plants from the Indo-Burmese element, Indo-Chinese element, and the Malesian-element.

9. Utilization of Ferns and Fern Allies

On a worldwide basis ferns and fern allies are probably less important than flowering plant for utilization. However, ferns and fern allies were recorded as ornamental plants, food plants, medicinal plants, and plant materials for the manufacture of handicrafts (Boonkerd, 1996).

9.1 Ornamental plants

Ferns and fern allies are worldwide used as ornamental plants both indoor and outdoor. The following species listed below were used or recommend to use as ornamental plants (สาธินีย์ ยุกตะนันทน์, 2539; ทวีศักดิ์ บุญเกิด, 2523; Boonkerd, 1996).

Adiantum zollingeri Mett. ex Kuhn

Adiantum philippense L.

Aglaomorpha coronans (Wall. ex Mett.) Copel.

Angiopteris evecta (G. Forst) Hoffm.

Asplenium nidus L. var. *nidus*

Blechnum orientale L.

Cibotium barometz J. Sm.

Davallia denticulata (Burm. f.) Mett. ex Kuhn

Davallia solida (G. Forst.) Sw.

Dicranopteris linearis (Burm. f.) Underw. var. *linearis*

Doryopteris ludens (Wall ex Hook.) J. Sm.

Drynaria quercifolia (L.) J. Sm.

Drynaria rigidula (Sw.) Bedd

Huperzia hamiltonii (Spreng.) Trevis

Lycopodiella cernua (L.) Pichi Serm.

Lygodium microphyllum (Cav.) R. Br.

Microsorum punctatum (L.) Copel.

Microsorum nigrescencs (Blume) Copel.

Nephrolepis biserrata (Sw.) Schott

Nephrolepis hirsutula (G. Forst.) C. Presl

Platycerium holttumii Jonch. & Hennipman

Psilotum nudum (L.) Beauv.

Pityrogramma calomelanos (L.) Link.

Pteris biaurita L.

Pyrrosia stigmosa (Sw.) Ching

9.2 Food plants

It has long been known that young leaves of ferns and fern allies are palatable enough to use as vegetables. Fresh leaves of the four species namely *Blechnum oreintale* L., *Ceratopteris thalictroides* (L.) Brongn., *Diplazium esculentum* (Retz.) Sw., and *Stenochlaena pulustris* (Burm. f.) Bedd. were reported as vegetables (มานิตย์ ออพานิชกิจ, 2530; บุษบา โชคช่วยพัฒนากิจ, 2539; ทวีศักดิ์ บุญเกิด, 2523; Boonkerd, 1996).

9.3 Medicinal plants

Ferns and fern allies of various species were investigated for medicinal value, these invaluable findings were passed from generation to generation. Table 6.1 shows 15 species of ferns from Huaiyang National Park were recorded as medicinal plants (ทวีศักดิ์ บุญเกิด, 2524; Tagawa & K. Iwatsuki, 1979; Boonkerd, 1996).

Table 6.1 Fifteen fern species can be used as medicinal plants.

Species	Part uses	Remedy
1. *Adiantum caudatum* L.	Root,rhizome,leaves	Thoracalgia
2. *Angiopteris evecta* (G. Forst) Hoffm.	Root,rhizome	fever
3. *Asplenium nidus* L. var. *nidus*	Root, rhizome	Allergies
4. *Blechnum oreintale* L.	Root,rhizome,leaves	Uropathy
5. *Bolbitis appenculata* (Willd. K. Iwats.) subsp. *Appenculata*	Rhizome	Pneumonia
6. *Ceratopteris thalictroides* (L.) Brongn.	Leaves	Skin pain
7. *Cibotium barometz* J. Sm.	Hairs	Styptic for wounds
8. *Diplazium esculentum* (Retz.) Sw.	Root,rhizome,leaves	fever
9. *Davallia solida* (G. Forst.) Sw.	Rhizome	Theriaca
10. *Dicranopteris lnearis* (Burm. f.) Undrew. var. *linearis*	Root,rhizome,leaves	Wormicide
11. *Drynaria bonii* H.Christ	Rhizome	Allergies
12. *Drynaria quercifolia* (L.) J. Sm	Root,rhizome,leaves	Wormicide
13. *Lindsaea ensifolia* Sw.	Root,rhizome	Wormicide
14. *Stenochlaena palustris* (Burm. f.) Bedd.	Root,rhizome,leaves	Diuretics
15. *Tectaria impresa* (Fée) Holttum	Rhizome	Scarlet fever and the menses fever

9.4 Miscellaneous Uses

The stipe of *Lygodium salicifolium* C. Presl was used commercially for the weaving of handicrafts such as handbags etc. (Boonkerd, 1996).

10. Comparison of Ferns and Fern allies Diversity

The continuous surveys of ferns and fern allies in a specific area were rarely carried out. So the comparison of pteridophytes diversity will be made from three sites quite far from each other. Khunkorn Waterfall Forest Park and Sakaerat Environmental Research Station were selected for this comparison..

10.1 Khunkorn Waterfall Forest Park ranges from 570 to 1,650 m above sea level. This forest park consisted of Moist Upper Mixed Deciduous Forest, Dry Upper Mixed Deciduous Forest and Hill Evergreen Forest. The total area is about 18 km^2. Average annual rainfall was 1,755 mm, maximum annual rainfall was observed in August. Average annual temperature was 24.1°C, and average annual relative humidity is 77%.

One hundred and fifty-three species in 56 genera from 24 families of ferns and fern allies were found in this study area (ปิยพงศ์ ราชตา, 2543). It was found that 56 species of ferns and fern allies were in common with the collecion at Huaiyang Waterfall National Park.

10.2 Sakaerat Environmental Research Station ranges in elevation from 250 to 762 m. This station is a protected area, consisted of Dry Evergreen Forest, Dipterocarp Forest, Mixed Deciduous Forest and grassland. The whole area is about 78 km^2. Average annual rainfall was 1,260 mm and average annual temperature was 26 °C, average maximum annual temperature 37 °C in March, and average annual relative humidity is 75%.

Sixty-eight species in 32 genera from 19 families of ferns and fern allies were found in this studied area (ทวีศักดิ์ บุญเกิด, 2523). It was found that 36 species of ferns and fern allies from this site were in common with the collection at Huaiyang Waterfall National Park.

The following 18 species of ferns and fern allies were found in all the three studied sites.

Adiantum caudatum L.
Aglaomorpha coronans (Wall. ex Mett.) Copel.
Angiopteris evecta (G. Forst) Hoffm.
Antrophyum callifolium Blume
Asplenium nidus L. var. *nidus*

Diplzium simplicivenium Holttum

Drynaria rigidula (Sw.) Bedd.

Lindsaea ensifolia Sw.

Lygodium salicifolium C. Presl

Microlepia speluncae (L.) Moore

Microlepia strigosa (Thunb.) C. Presl

Microsorum pteropus (Blume) Copel.

Microsorum punctatum (L.) Copel.

Microsorum zipelii (Blume) Ching

Pteris venusta Kunze

Pyrrosia stigmosa (Sw.) Ching

Tectaria impressa (Fée) Holttum.

Thelypteris parasitica (L.) Fosberg

They are common ferns species distribute throughout the country in Dry Evergreen Forest, Mixed Deciduous Forest and Dipterocarp Forest. The diversity of ferns and fern allies of these three studied sites are compared in Table 6.2.

Table 6.2 Comparison of Ferns and Fern allies Diversity in three studied sites.

Studied site	Total area (km^2)	Diversity of Fern and Fern allies		
		Family	Genus	Species
Khunkorn Waterfall Forest Park	18	24	56	153
Sakaerat Environmental Research Station	78	19	32	68
Huaiyang Waterfall National Park	161	26	57	126

It was found that, ferns and fern allies diversity at Huaiyang Waterfall National Park and Khunkorn Waterfall Forest Park was over 100 species as compared with the Sakaerat Environmental Research Station. These dicrepancy probably due to the different in ecosystem diversity of the three studied sites. Ferns and fern allies diversity at Sakaerat Environmental Research Station is rather low may be explained by its drier habitats of Dipterocarp Forest and Grassland, whilst Moist Upper Mixed Deciduous Forest, Tropical Evergreen Forest and Hill Evergreen Forest were the main

vegetations at Huaiyang Waterfall National Park and Khunkorn Waterfall Forest Park. Taking the area into account, it was found that ferns and fern allies diversity at Khunkorn Waterfall Forest Park was much higher than at Huaiyang Waterfall National Park, though the area was very much smaller. This result can also explain by the difference in ecosystem diversity, especially the area of Hill Evergreen Forest. Though, Huaiyang Waterfall National Park has much larger area, but however only 2% (3.64 km^2) covered by a Hill Evergreen Forest. In contrast, most of Khunkorn Waterfall Forest Park area are Moist Upper Mixed Deciduous Forest and Hill Evergreen Forest. These two vegetations are favorable habitats for ferns and fern allies to flourish.

11. Difficulties Encountered

1. The studied site was influenced by seasonal monsoons, with a heavy rain all the year round. So it was rather difficult during fieldtrips to take a photography and search for a small plants.

2. The studied site is a mountainous area with rather steep slopes. This location made a long difficult journey to get to the summit of Khao Luang.

3. Morphological variations in each species of ferns were rather high, this is resulted in difficulty in determination of the related species from the keys available in Flora of Thailand, volume 3.

4. The voucher specimens at BCU and BKF are not available in some problematical species, so uncertain determinations were unavoidably made in some species .

12. Recommendation

1. The diagnostic characters of each genera should be born in mind before a field trip has been made, to ensure all necessary plant-parts will be collected during a field trip.

2. Due to the time limit and the difficulty to access in some studied area, for example, steep cliffs, chasms, some species will be overlooked. Some more field trips should be made during dry months.

3. Some uncommon species of ferns and fern allies are found in this studied site. The tight measures to protect and conserve wild plant species should be performed.

13. Benefit of This Research

1. The fundamental data on species diversity of ferns and fern allies in Huaiyang Waterfall National Park was known.

2. Key to the genera and species of ferns and fern allies using plant materials collected from Huaiyang Waterfall National Park can be used for this plant group in adjacent areas.

3. Total number of voucher specimens at the Professor Kasin Suvatabhanda Herbarium (BCU), Department of botany will be increased by the collected specimen from this study.

4. Knowledge gained from this study may be in part can be used in conservation and tourism promotion programs.

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APPENDIX I

ABBREVIATION

A	=	aquatic
a.s.l.	=	above sea level
C	=	common
cm	=	centimetre
DEF	=	dry evergreen forest
diam.	=	diameter
E	=	epiphyte
E.	=	east
eds.	=	editor
ed.	=	edition
e.g.	=	for example
et al.	=	and other
ex	=	from
f.	=	son
Fig.	=	figure
HEF	=	Hill evergreen forest
km	=	kilometre
L	=	lithophyte
m	=	metre
MDF	=	mixed deciduous forest
mm	=	millimetre
N.	=	north
NW.	=	north-west
no.	=	number
photo.	=	photograph
SC	=	slightly common
sp.	=	species (singular)
spp.	=	species (plural)
subsp.	=	subspecies
S.	=	south
SE.	=	south-east

SW.	=	south-west
T	=	terrestrial
TEF	=	tropical evergreen forest
UC	=	uncommon
VC	=	very common
° C	=	degree Celsius
%	=	percent
var.	=	variety
vol.	=	volume
W.	=	west

BIOGRAPHY

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