

การทบทวนอนุกรมวิธานเฟิร์นสกุล *Tectaria* Cav. (TECTARIACEAE) ในประเทศไทย



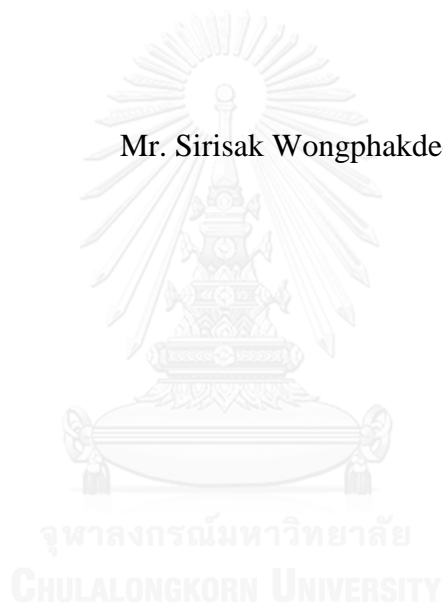
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TAXONOMIC REVISION OF FERN GENUS *Tectaria* Cav. (TECTARIACEAE) IN  
THAILAND

Mr. Sirisak Wongphakdee



A Thesis Submitted in Partial Fulfillment of the Requirements  
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Faculty of Science  
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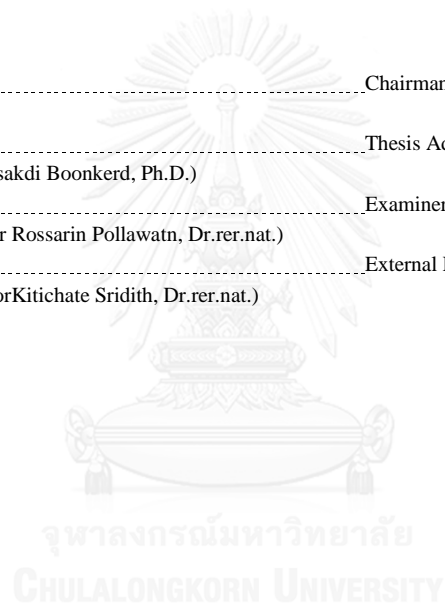
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ศิริศักดิ์ วงศ์ศักดิ์ : การทบทวนอนุกรมวิธานเฟิร์นสกุล *Tectaria* Cav. (TECTARIACEAE) ในประเทศไทย (TAXONOMIC REVISION OF FERN GENUS *Tectaria* Cav. (TECTARIACEAE) IN THAILAND) อ.ที่ปรึกษาวิทยานิพนธ์หลัก: ศ. ดร. ทวีศักดิ์ บุญเกิด, หน้า.

เฟิร์นสกุล *Tectaria* Cav. มีความแปรผันของลักษณะทางสัณฐานวิทยามาก เนื่องด้วยความไม่ชัดเจนของลักษณะทางสัณฐานวิทยาที่อธิบายในรูปวิธานและคำบรรยายลักษณะของเฟิร์นสกุลนี้บางชนิดในหนังสือพรรณพฤกษชาติประเทศไทย นำไปสู่ความผิดพลาดต่อการจัดจำแนกชนิด อนึ่ง มีการพบเฟิร์นสกุล *Tectaria* ชนิดใหม่ในประเทศไทยเพิ่มมากขึ้น ทำให้ข้อมูลทางอนุกรมวิธานที่มีอยู่เดิมนั้น ไม่สามารถใช้กับชนิดต่างๆ เหล่านี้ได้ และจากการศึกษาทางวิวัฒนาการชาติพันธุ์ส่งผลให้ขอบเขตของเฟิร์นสกุลนี้กว้างขึ้น โดยรวมเฟิร์นสกุลใกล้เคียงไว้ด้วย งานวิจัยนี้จึงมีวัตถุประสงค์เพื่อศึกษาทบทวนอนุกรมวิธานของเฟิร์นสกุล *Tectaria* ในประเทศไทย โดยศึกษาลักษณะทางสัณฐานวิทยาอย่างละเอียดจากพรรณไม้แห้งในพิพิธภัณฑ์พืชทั้งในประเทศไทยและต่างประเทศ อีกทั้งยังศึกษาลักษณะทางกายวิภาคศาสตร์และลักษณะของสปอร์ของชนิดที่คล้ายคลึงกันอย่างละเอียดอีกด้วย

ผลการศึกษา พบว่า ลักษณะของใบและเกล็ด ลักษณะการจัดเรียงตัวของเส้นใบ ตำแหน่งของกลุ่มอับสปอร์ และลวดลายของสปอร์ที่ชั้นเพอริสปอร์ เป็นลักษณะสำคัญที่ใช้ในการจัดจำแนกเฟิร์นสกุลนี้ ในประเทศไทยพบเฟิร์นสกุล *Tectaria* ทั้งหมด 54 ชนิด ซึ่งรวม 5 ชนิดจาก สกุล *Heterogonium* C. Presl และ *Quercifilix* Copel. ที่ถูกยุบรวมไว้ด้วย พบเฟิร์นชนิดใหม่ของไทยเพิ่มขึ้น 11 ชนิด ได้แก่ *T. acrocarpa* (Ching) Christenh., *T. aurita* (Sw.) S. Chandra, *T. chattagramica* (C.B. Clarke) Ching, *T. hymenophylla* (Parish ex Bedd.) Holttum, *T. kehdingiana* (Kuhn) M.G. Price, *T. multicaudata* (C.B. Clarke) Ching, *T. poilanei* Tardieu, *T. subpedata* (Harr.) Ching, *T. subvariolosa* S.Y. Dong, *T. trichotoma* (Fée) Tagawa และ *T. zippelii* S.Y. Dong พบชนิดที่คาดว่าจะเป็ชนิดใหม่ของโลก 9 ชนิด และพบว่ามีเฟิร์นสกุลนี้ 11 ชนิดที่เป็นพืชเฉพาะถิ่นของไทย ทั้งนี้ มีบางชนิดที่ควรกำหนดตัวอย่างเลือกเป็นตัวอย่างต้นแบบขึ้นใหม่ทั้งสิ้น 16 ชนิดรวมทั้งชนิดที่เป็นชื่อพ้อง และ *T. keckii* (Luerss.) C. Chr. ควรจัดทำตัวอย่างอ้างอิงเพิ่มเติมจากตัวอย่างต้นแบบแรก ในการศึกษาได้จัดทำรูปวิธานขึ้นใหม่ พร้อมทั้งคำบรรยายลักษณะ ภาพวาดลายเส้นรูปภาพ ชื่อพ้องต่างๆ และบัญชีรายละเอียดของพรรณไม้อ้างอิงในแต่ละชนิดไว้ด้วย ทั้งนี้ การประเมินสถานภาพของชนิดที่มีความเสี่ยงวิกฤตต่อการสูญพันธุ์อย่างยิ่งได้รับการอภิปรายไว้ด้วย



ภาควิชา พฤกษศาสตร์

ลายมือชื่อนิสิต .....

สาขาวิชา พฤกษศาสตร์

ลายมือชื่อ อ.ที่ปรึกษาหลัก .....

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KEYWORDS:

SIRISAK WONGPHAKDEE: TAXONOMIC REVISION OF FERN GENUS *Tectaria* Cav. (TECTARIACEAE) IN THAILAND. ADVISOR: PROF. THAWEESAKDI BOONKERD, Ph.D., pp.

Due to a great number of variations in morphological characters and the ambiguity of some diagnostic characters using in a key and descriptions of *Tectaria* Cav. in the Flora of Thailand leading to confusing in species determination in most Thai herbaria. Moreover, some new taxa were added to the Thai Flora without any amended key-to-species. On a worldwide basis the genus boundary of *Tectaria* was extended to include some related genera based on recent phylogenetic studies. Thus, the preceding taxonomic information of Thai *Tectaria* was inappropriate. The objective of this research was to revise the genus *Tectaria* in Thailand based on the existing herbarium specimens in Thailand and abroad, together with some additional field collections. Intensive morphological, anatomical and palynological examinations were carried out, especially in pair/group of confused species.

Frond and scale characters, venation patterns, sori distribution, and perispore ornamentation are important and useful characters for species delimitation. Fifty-four species are recognized which included five species of the previously recognized *Heterogonium* C. Presl and *Quercifilix* Copel. Among these 11 species are new records, viz. *T. acrocarpa* (Ching) Christenh., *T. aurita* (Sw.) S. Chandra, *T. chattagramica* (C.B. Clarke) Ching, *T. hymenophylla* (Parish ex Bedd.) Holttum, *T. kehdingiana* (Kuhn) M.G. Price, *T. multicaudata* (C.B. Clarke) Ching, *T. poilanei* Tardieu, *T. subpedata* (Harr.) Ching, *T. subvariolosa* S.Y. Dong, *T. trichotoma* (Fée) Tagawa and *T. zippelii* S.Y. Dong, nine species tend to be new to science and 11 species are endemic to Thailand. Lectotypification of 16 species and epitypification of *T. keckii* are proposed. A key to the species is provided, as well as descriptions, illustrations, photograph, synonymy, and a list of examined specimens for each species. The evaluation of some critically endangered species are discussed.



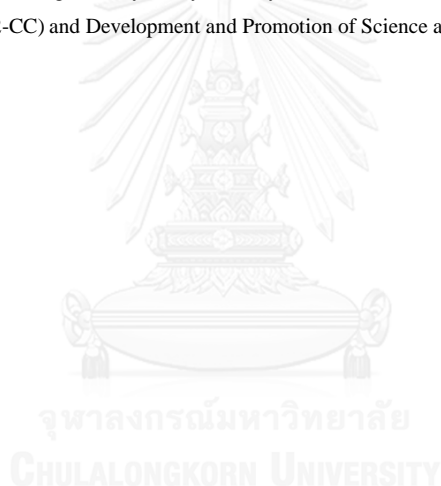
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Advisor's Signature .....

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## LIST OF ABBREVIATION

A	Herbarium of the Arnold Arboretum, Harvard University, Cambridge, Massachusetts, USA
B	Botanischer Garten und Botanisches Museum Berlin-Dahlem, Zentraleinrichtung der Freien Universität Berlin, Berlin Germany
BCU	Professor Kasin Suvatabandhu Herbarium, Department of Botany, Faculty of Science, Chulalongkorn University, Bangkok, Thailand
BK	Bangkok Herbarium, Plant Variety Protection Office, Department of Agriculture, Bangkok, Thailand
BKF	Forest Herbarium, National Park, Wildlife and Plant Conservation Department, Bangkok, Thailand
BM	Cryptogamic Herbarium, The Natural History Museum, London, UK
BO	Herbarium Bogoriense, Botany Division, Research Centre for Biology, Cibinong, Indonesia
BR	Herbarium, Botanic Garden Meise, Meise, Belgium
C	Herbarium, Botanical Garden, University of Copenhagen, Copenhagen, Denmark
CMU	Herbarium, Faculty of Pharmacy, Chiang Mai University, Chiang Mai, Thailand
CMUB	Herbarium, Department of Biology, Faculty of Science, Chiang Mai University, Chiang Mai, Thailand
E	Herbarium, Royal Botanic Garden Edinburgh, Edinburgh, Scotland, UK
et al.	et alii [masculine], et aliae [feminine] or et alia [neuter]
excl. var.	exclusis varietatibus
F	Herbarium, Botany Department, Field Museum of Natural History, Chicago, Illinois, USA
G	Herbarium, Conservatoire et Jardin botaniques de la Ville de Genève, Genève, Switzerland
GH	Herbaria, Harvard University, Cambridge, Massachusetts, USA
<i>in adnot.</i>	<i>in adnotatio</i>
K	Herbarium, Royal Botanic Gardens, Kew, Richmond, Surrey, England, UK
KKU	Herbarium, Department of Biology, Khon Kaen University, Khon Kaen, Thailand

KUN	Herbarium, Kunming Institute of Botany, Chinese Academy of Sciences, Yunnan, People's Republic of China
KYO	Herbarium, Botany Department, Graduate School of Science, Kyoto University, Kyoto, Japan
L	Nationaal Herbarium Nederland, Botany Section, Naturalis, Naturalis Biodiversity Center, Leiden, The Netherlands
LD	Herbarium, Botanical Museum, Lund University, Lund, Sweden
LE	Herbarium, Russian Academy of Sciences, V. L. Komarov Botanical Institute, Saint Petersburg, Russia
LINN	Herbarium, Linnean Society of London, London, England, UK
M	Herbarium, Botanische Staatssammlung München, München, Germany
MICH	Herbarium, University of Michigan, Michigan, USA
MPU	Herbier, Institut de Botanique, Université Montpellier, Montpellier, France
n/a	not available
<i>nom. illeg. hom.</i>	<i>nomen illegitimum homonymum</i>
<i>nom. nud.</i>	<i>nomen nudum</i>
<i>nom. superfl.</i>	<i>nomen superfluum</i>
<i>n.v.</i>	<i>non vidi</i>
NY	William and Lynda Steere Herbarium, The New York Botanical Garden, Bronx, New York
p.p.	pro parte
P	Herbier National de Paris, Département de Systématique et Evolution, Phanérogamie, Muséum National d'Histoire Naturelle, Paris, France
PE	Chinese National Herbarium, Institute of Botany, Chinese Academy of Sciences, Beijing, People's Republic of China
PH	Herbarium, Botany Department, Academy of Natural Sciences, Philadelphia, Pennsylvania, USA
PRC	Herbarium, Department of Botany, Faculty of Natural Sciences, Charles University in Prague, Praha, Czech Republic
QBG	Herbarium, Queen Sirikit Botanic Garden, Mae Rim, Chiang Mai, Thailand
RB	Herbário, Instituto de Pesquisas, Jardim Botânico do Rio de Janeiro, Rio de Janeiro, Brazil
S	Herbarium, Swedish Museum of Natural History, Stockholm, Sweden
SBT	Herbarium, The Bergius Foundation at the Royal Swedish Academy of Sciences, Stockholm, Sweden

<i>s.coll.</i>	<i>sine collectour</i>
<i>sensu auct.</i>	<i>sensu auctorum</i> (singular)
<i>sensu auctt.</i>	<i>sensu auctorum</i> (plural)
SING	Herbarium, Singapore Botanic Gardens, Singapore
<i>s.l.</i>	<i>sine loco</i>
<i>s.n.</i>	<i>sine numero</i>
TAI	Herbarium, College of Life Science, National Taiwan University, Taipei, Taiwan
TAIF	Herbarium, Taiwan Forestry Research Institute, Taipei, Taiwan
TI	Herbarium, University Museum, University of Tokyo, Tokyo, Japan
U	National Herbarium Netherland, Botany Section, Naturalis, Naturalis Biodiversity Center, Leiden, The Netherlands
UC	University Herbarium, University of California, Berkeley, California, USA
UKMB	Herbarium, Botany Department, Universiti Kebangsaan Malaysia, Selangor, Malaysia
UPM	Herbarium, Department of Biology, Faculty of Science, Universiti Putra Malaysia, Selangor, Malaysia
US	United States National Herbarium, Department of Botany, Smithsonian Institution, Washington, District of Columbia, USA
Z	Herbarium, Institut für Systematische Botanik, Universität Zürich, Zürich, Switzerland

# CHAPTER I

## INTRODUCTION

### 1.1 Background and rationale

In general, pteridophyte is a large group of vascular plants that can be found elsewhere around the world with predominantly tropical distribution. Thailand is rich in pteridophyte diversity. Pteridophyte researches in Thailand have been studied for decades, especially in diversity. Tagawa and Iwatsuki studied pteridophytes in Thailand which had emphasized on Thai herbarium specimens and some additional fieldworks. Thirty four families, 121 genera and 630 species were enumerated (Tagawa and Iwatsuki, 1979; 1985, 1988, 1989). Boonkerd and Pollawatn (2000) compiled data from various sources and from their own field trips to publish a checklist of pteridophytes in Thailand. They enumerated 35 families, 139 genera, 671 species, 4 subspecies, and 28 varieties, including 27 new records for Thailand.

The fern genus *Tectaria* Cav. is terrestrial or epipetric, comprising 150–210 species in the tropics (Holttum, 1991b; Kramer, 1990; Mabberley, 2008). Currently, the genus is belonged to its own family Tectariaceae (Christenhusz et al., 2011; Mabberley, 2008; Panigrahi, 1986; Smith et al., 2006). *Tectaria* has a wide distribution throughout Thailand in various types of vegetation, which usually grow in shady places from lowlands to mountainous areas in mixed deciduous forest to hill evergreen forest. Interestingly, many *Tectaria* species have extremely diverse morphology. The genus has a great number of variations among species in both vegetative and reproductive features. In general, rhizomes are erect or creeping. Fronds are monomorphic to strongly dimorphic and various in form from simple to pinnately compound leaves. Venation patterns are diverse from fully free veins to variously anastomosing which included or excluded free veinlets in areoles. Sori are usually round or sometimes elongate which are produced on terminal of free veins, having sori borne at the junction of two veins, or on adjacent anastomosing veins. In addition, some species have acrostichoid sporangia. Indusia are round to reniform in some species while some species are exindusiate. Meanwhile, some species are specially adapted to grow on limestone rocks (Holttum, 1991b; Tagawa and Iwatsuki, 1988; Xing et al., 2013). Interestingly, some *Tectaria* species in Thailand, such as *T. coadunata* (J. Sm.) C. Chr. and *T. impressa* (Fée) Holttum, are reported to have medicinal value (Mori et al., 2013; ทวีศักดิ์ บุญเกิด, 2524).

Up to now, some taxonomic information of *Tectaria* in Thailand remains unclear. Firstly, a key to the species and descriptions of some species in Flora of Thailand needed some important characters for species delimitation, i.e. *T. herpetocaulos* Holttum, *T. laotica* Tardieu & C. Chr., and *T. rumicifolia* (Alderw.) C. Chr. Consequently, it is difficult to identify them accurately. Besides, unknown species of *Tectaria* were found in some taxonomic studies of pteridophyte diversity in many parts of Thailand (Boonkerd et al., 2008; Boonkerd and Pollawatn, 2006; Niyomdee, 2012; Simma, 2008). Secondly, new species, i.e. *T. phanomensis* S. Linds., and new records, i.e. *T. remotipinna* Chu H. Wang, and *T. shahidaniana* Rusea, were added to the Thai Flora, but key-to-species for the Thai *Tectaria* account

is not available . Thirdly, previous updated studies in molecular phylogenies and re-examination of type specimens demonstrated that there are new combinations in the genus *Tectaria* from its allied genera (*Ctenitis* (C. Chr.) C. Chr., *Heterogonium* C. Presl, *Quercifilix* Copel.). Some species were also proposed as synonyms (Christenhusz, 2010; Ding et al., 2014; Ding et al., 2013; Dong, 2014; Holttum, 1991b; Lindsay et al., 2009; Mazumdar, 2014; Tagawa and Iwatsuki, 1989). Hence, a key-to-species and descriptions are not relevant to the morphology of the present known species. The fern genus *Tectaria* in Thailand is needed to be revised.

## 1.2 Aim of thesis

This study aims to revise the account of genus *Tectaria* based mainly on re-examining morphological and anatomical features of all Thai species. Keys, descriptions, distribution in Thailand and ecology will be amended, rewritten or reconstructed.



## CHAPTER II

### TAXONOMIC HISTORY

#### 2.1 *Tectaria*: an overview

*Tectaria* is a terrestrial or epipetric fern, comprising about 150–210 species in the tropical and subtropical regions (Holttum, 1991b; Kramer, 1990; Mabberley, 2008). Southeast Asia was regarded as the center of origin of this genus (Holttum, 1991b). It was previously placed in the family Aspidiaceae (Pichi Sermolli, 1977), in Dennstaedtiaceae (Rusea et al., 2004), and in Dryopteridaceae (Kramer, 1990; Moran, 1993; Tagawa and Iwatsuki, 1988). Currently, the genus is placed in its own family Tectariaceae (Christenhusz et al., 2011; Mabberley, 2008; Panigrahi, 1986; Smith et al., 2006). *Tectaria* was segregated from the genus *Polypodium* L. and firstly described as a genus for ferns which having round sori, scattering on abaxial surface of lamina and enveloped with round indusia (Cavanilles, 1799). Cavanilles cited *T. trifoliata* (L.) Cav. as the type species. Later, he added the other twelve species that have common characters into *Tectaria* (Cavanilles, 1802). However, some of them are now placed in the genus *Dryopteris*, *Nephrolepis*, *Polystichum*, *Thelypteris* and the other genera (Holttum, 1991b).

Later, Swartz (1801) established the genus *Aspidium* with a similar wide-ranging circumscription, including *T. trifoliata* (L.) Cav., the original species cited by Cavanilles. *Aspidium* Sw. was accepted as a valid name by some authors (Blume, 1828; Hooker, 1862). *Aspidium trifoliatum* (L.) Sw. was published as the type species of *Aspidium* which was the same type species of *Tectaria*. Therefore, *Aspidium* should be a superfluous name.

Due to morphological variations among species of *Tectaria sensu lato*, many attempts have been made to segregate *Tectaria* into various satellite genera, based mainly on characters of venation and indusia, i.e., *Amphiblestra* C. Presl, *Bathmium* C. Presl ex Link, *Camptodium* Fée, *Cardiochlaena* Fée, *Chlamydogramme* Holttum, *Cionidium* T. Moore, *Ctenitopsis* Ching ex Tardieu & C. Chr., *Dictyoxiphium* Hook., *Dryomenis* Fée, *Fadyenia* Hook., *Heterogonium* C. Presl, *Luerssenia* Kuhn, *Microbrochis* C. Presl, *Pleuroderris* Maxon, *Podopeltis* Fée, *Polydictyum* C. Presl, *Pseudotectaria* Tardieu-Blot, *Psomiocarpa* C. Presl, *Quercifilix* Copel., *Sagenia* C. Presl, and *Stenosemia* C. Presl (Christensen, 1940; Copeland, 1928; Fée, 1852; Henfrey et al., 1852; Holttum, 1986b; Hooker, 1840; Link, 1841; Luerssen, 1882; Maxon, 1934; Presl, 1836, 1849, 1851; Tardieu, 1955; Tardieu and Christensen, 1941).

For decades, genus circumscription of *Tectaria* has been continuously debated among botanists. Some authors defined the generic boundary of *Tectaria* in a narrow sense which included only plants with monomorphic fronds, veins fully anastomosing, and sori being separated, round, and covered with indusia (Ching, 1978; Copeland, 1960; Pichi Sermolli, 1977; Tardieu and Christensen, 1941; Wang, 1999). By way of contrast, some botanists recognized *Tectaria* in a broad sense, inclusive of plants with monomorphic or dimorphic fronds and acrostichoid sporangia abaxially (*Hemigramma* Copel., *Quercifilix* Copel., *Stenosemia* C. Presl, etc.) and

included some ferns with free veins in the genus *Ctenitopsis* Ching ex Tardieu & C. Chr. into *Tectaria* (Holttum, 1986a, 1988, 1991a, 1991b; Kramer, 1990; Smith et al., 2006; Tagawa and Iwatsuki, 1988).

Regarding to *Ctenitopsis*, Holttum (1988, 1991b) noticed the different shape of basal pinna and determined *Ctenitopsis* as a combination of two genera. He placed *Ctenitopsis* species which bearing basal basiscopic pinnules or lobes in *Tectaria* whereas the species with reduced basiscopic pinnules or lobes should be included in *Heterogonium* C. Presl.

Subdivision of *Tectaria* was divided by Ching and Wang (1983) into two sections, four series, and four grex. The section *Tectaria* was determined by having large sori which located on free included veinlets in areoles and covered with large and persistent indusia, while the section *Myriocarpos* Ching had smaller sori which located on anastomosing veins and covered with small and caducous indusia. Among series and grex established under the two sections, they were separated by considering the difference of venation pattern, winged occurrence at stipe, and shape of apical lamina. In contrast to Ching's opinion, Holttum divided *Tectaria* s.l. into two sections based on the venation pattern. The section *Sagenia* (C. Presl) Holttum included species having either free veins, or partially anastomosing veins, occurring alongside with costa. In section *Tectaria*, only species having fully anastomosing veins with free veinlets was included (Holttum, 1986a, 1991b). Due to the absence of morphological analyses within the genus *Tectaria*, botanists have made different opinions in evaluating the taxonomic values of each character. Therefore, these arguments gave rise to wide disagreement on the genus circumscription and the subdivision of this genus (Ding et al., 2014).

Recently, based on phylogenetic analyses using a combination of morphological and molecular data, the results supported the monophyly of *Tectaria* in a broad sense. So, the previous recognized satellite genera: *Amphiblestra*, *Bathmium*, *Camptodium*, *Cardiochlaena*, *Chlamydogramme*, *Cionidium*, *Ctenitopsis*, *Dictyoxiphium*, *Dryomenis*, *Fadyenia*, *Grammatosorus*, *Hemigramma*, *Heterogonium*, *Lenda*, *Luerssenia*, *Microbrochis*, *Phlebiogonium*, *Pleuroderris*, *Podopeltis*, *Psomiocarpa*, *Quercifilix*, *Stenosemia*, and *Tectaridium* should be included in *Tectaria* (Christenhusz et al., 2011; Ding et al., 2014; Smith et al., 2006; Wang et al., 2014). In addition, Ding et al. (2014) suggested that the variation of venation pattern and the base chromosome number ( $x = 40$ ) should be considered as two synapomorphic characters for *Tectaria*. However, further phylogenetic analysis with more sample taxa worldwide should be used to understand the relationship within *Tectaria*. In addition, it was suggested that cytological data, i.e. chromosome number, polyploid level, hybridization, etc., are insignificant for understanding the evolution of morphological characters and the relationships within *Tectaria*.

## 2.2 *Tectaria* in Thailand

The first taxonomic account of Thai *Tectaria*, *Aspidium variolosum* Wall., a synonym of *Tectaria impressa* (Fée) Holttum, was reported in Flora of Koh Chang from the specimens collected by Johannes Schmidt during his expedition during 1899-1900 (Schmidt, 1900). Later, unknown specimens from many collections in Thailand were studied by pteridologists. Two *Tectaria* species, i.e. *T. rockii* C. Chr., and *T. gymnosora* Holttum. were then reported as new to science. *T. rockii* was found

between Palut and Nam Dip, on the trail from Raheng (Tak province) to Mae Sot, Northern Thailand (Christensen, 1940). *T. gymnosora* was a terrestrial fern in evergreen forest at 700 m in Salaëng Haeng, Phitsanulok province, northern Thailand (Holtum, 1966). Then, 25 species have been enumerated in the Flora of Thailand (Tagawa and Iwatsuki, 1988). Later, previous updated studies in molecular phylogenies and re-examination of type specimens brought about some new combinations to the genus *Tectaria* from its allied genera and some species were proposed as synonyms. *T. coadunata* (J. Sm.) C. Chr. and *T. variolosa* (Wall. ex Hook.) C. Chr. were transferred to be synonym of *T. christii* Copel. and *T. impressa* (Fée) Holtum, respectively. In addition, *T. manilensis* (C. Presl) Holtum was removed from the genus *Ctenitis* (Holtum, 1984) and was added to the Thai *Tectaria* in 1989 (Tagawa and Iwatsuki, 1989). However, many collections of pteridophytes have been made throughout Thailand after the Pteridophyte Flora of Thailand had published. It was found that there are still some unknown *Tectaria* species and need further investigation (Boonkerd et al., 2008; Boonkerd and Pollawatn, 2006; Niyomdee, 2012; Simma, 2008).

In 2000, a checklist of pteridophytes in Thailand with distribution map of each species was published. For the fern genus *Tectaria*, four more species have been included in the Thai *Tectaria* account, i.e. *T. brachiata* (Zoll. & Moritz) C.V. Morton, *T. keckii* (Luer) C. Chr., *T. pilosa* (Fée) R.C. Moran and *T. siifolia* (Willd.) Copel. (Boonkerd and Pollawatn, 2000). However, up to now the presence of these four species in Thailand is still dubious due to disagreement in recognition of species. *T. amplifolia* (Alderw.) C. Chr., for example was treated by Holtum as a synonym of *T. keckii*, while both species have been recognized as 2 valid species. In addition, this disagreement can also be found in the identification of *T. siifolia* and *T. ternifolia* (Alderw.) C. Chr. (Boonkerd and Pollawatn, 2000; Lindsay et al., 2009). Holotype of *T. pilosa* at Kew Herbarium collected by Beusekom & Phengklai from Kanchanaburi, Thailand is needed further investigation. *T. zeilanica* (Houtt.) Sledge, was removed from the genus *Quercifilix* (Sledge, 1972) and was added to the Thai *Tectaria* account (Lindsay et al., 2009).

Recently, *T. phanomensis* S. Linds. was described as a new species. It occurred in thin soil on a limestone cliff at about 100 m altitude in Khlong Phanom National Park, Surat Thani province, peninsular Thailand (Lindsay et al., 2008). Then, *T. shahidaniana* Rusea, was listed and mentioned as provisional new records (Lindsay et al., 2009), and pending for further investigation. Moreover, *T. remotipinna* Ching & Chu H. Wang was published as a new record. It grew on streambanks in lower montane or hill evergreen forest over granite bedrock at 1,000–1,450 m alt. in some natural parks in Chiang Mai province, northern Thailand (Lindsay et al., 2013). According to the study of Ding et al. (2014) based on five regions of cpDNA (*atpB*, *ndhF* plus *ndhF-trnL*, *rbcL*, *rps16-matK* plus *matK*, and *trnL-F*), the monophyly of *Tectaria* in a broad sense meaning was accepted, in which *Ctenitopsis*, *Hemigramma*, *Heterogonium*, *Psomiocarpa*, *Quercifilix*, *Stenosemia*, and *Tectaridium* should be included. Thus, the combination of *Quercifilix* into *Tectaria* is confirmed from their study. Likewise, *Heterogonium* was transferred to *Tectaria* (Christenhusz, 2010; Dong, 2014; Mazumdar, 2014). The reduced basiscopic lobe at basal pinna was noted by Holtum (1988) as the diagnostic feature for *Heterogonium*. However, it is homoplastic in *Tectaria* and is not significant in recognizing the separation of



*Heterogonium* from *Tectaria* (Ding et al., 2014). Therefore, four species of *Heterogonium* in Thailand should be validated into *Tectaria*, i.e. *T. hennipmanii* (Tagawa & K. Iwats.) S.Y. Dong, *T. nayarii* Mazumdar, *T. sagenioides* (Mett.) Christenh., and *T. stenosemioides* (Alderw.) C. Chr. (Christenhusz, 2010; Christensen, 1934; Dong, 2014; Mazumdar, 2014). Recently, *T. kehdingiana* (Kuhn) M.G. Price was proposed as new record from peninsular Thailand (Wongphakdee et al., in press).



## CHAPTER III

### MATERIALS AND METHODS

This study was divided into three parts, viz. morphological and taxonomic, anatomical, and palynological studies. Herbarium specimens and some additional materials of *Tectaria* in Thailand were mainly used. Some specimens from nearby countries were investigated to improve the characteristics and distribution of each species. Anatomical and palynological studies were processed to support taxonomic information.

#### 3.1 Materials and methods for morphological and taxonomic studies

##### 3.1.1 Materials for specimen collection

- 3.1.1.1 Plant presses, c. 30 x 45 cm
- 3.1.1.2 Sheets of newspapers
- 3.1.1.3 Corrugated paperboards
- 3.1.1.4 Ropes for banding plant presses
- 3.1.1.5 Collector number cards
- 3.1.1.6 Pruning shear
- 3.1.1.7 Spade
- 3.1.1.8 Plastic bags
- 3.1.1.9 Zipper bags
- 3.1.1.10 Field notes
- 3.1.1.11 Digital camera, Nikon DSLR D600
- 3.1.1.12 The Global Position System (GPS) receiver, Garmin 60CSx

##### 3.1.2 Materials for herbarium specimen preparation

- 3.1.2.1 Hot air oven (35-60 °C)
- 3.1.2.2 Deep Freezer (-30 °C)
- 3.1.2.3 Mounting papers, c. 30 x 45(42) cm
- 3.1.2.4 Species covers, c. 30 x 45(42) cm
- 3.1.2.5 Genus cover, c. 30 x 45 cm
- 3.1.2.6 Mounting glue
- 3.1.2.7 Herbarium label, c. 10.5 x 13.5 cm
- 3.1.2.8 Sand bags
- 3.1.2.9 Needle and thread

##### 3.1.3 Materials for morphological and taxonomic studies

- 3.1.3.1 Compound light microscope
- 3.1.3.2 Stereomicroscope
- 3.1.3.3 Microscopic slides and cover glasses
- 3.1.3.4 Dissecting needles

3.1.3.5 Droppers

3.1.3.6 Razor blades

3.1.3.7 Forceps

3.1.3.8 Petri dishes

3.1.3.9 Taxonomic literatures, e.g. Floras, monographs, research articles, etc.

3.1.3.10 Herbarium specimens and virtual online database from main herbaria in Europe, Thailand, Malaysia and Singapore were studied, all herbarium acronyms are according to Index Herbariorum (Thiers, continuously updated).

### 3.1.4 Methodology for morphological and taxonomic studies

#### 3.1.4.1 Investigation taxonomic literatures

All available taxonomic literatures related to *Tectaria* species both in Thailand and neighboring countries were investigated. Taxonomic information of each *Tectaria* species in Thailand including a number of *Tectaria* species, morphological characters, ecological data, and distribution were compiled and noted.

#### 3.1.4.2 Morphological and taxonomic study

Herbarium specimens of all Thai specimens were examined. All studied materials of Thai *Tectaria* are deposited at B, BCU, BK, BKF, BM, CMU, CMUB, K, KKU, L, PSU, QBG and SING. In addition, the images of virtual online specimens of *Tectaria* in Thailand were observed from the following herbaria database, i.e. The Harvard University Herbarium (A; [http://kiki.huh.harvard.edu/databases/specimen\\_index.html](http://kiki.huh.harvard.edu/databases/specimen_index.html)), Royal Botanic Garden Edinburgh (E; <http://elmer.rbge.org.uk/bgbase/vherb/bgbasevherb.php>), Naturalis Biodiversity Center (L; <http://bioportal.naturalis.nl>), National D'Histoire Naturelle (P; <https://science.mnhn.fr>). Moreover, additional fieldworks in various parts throughout Thailand were carried out, covering various habitats, i.e. tropical evergreen forests, dry evergreen forests, mixed deciduous forests, limestone mountains. These explorations were emphasized on previous recorded location as well as unbotanized areas. Two or three specimens were collected for each species. In case of rare and threatened species, only one specimen was gathered. Specimen collections and preparation are according to Boonkerd et al. (1987). Morphological characters of vegetative and reproductive parts were investigated thoroughly. Besides, both qualitative and quantitative traits were examined. Then, species identification was based on key-to-species and description in the Flora of Thailand and taxonomic literatures from neighboring countries, i.e. Ching (1931), Copeland (1907, 1947), Holttum (1954, 1981, 1986a, 1986b, 1988, 1991a, 1991b), Piggott (1988), Tagawa and Iwatsuki (1988, 1989), Tardieu and Christensen (1941), Rusea et al. (2004), Wang (1999), Xing et al. (2013). All Thai *Tectaria* specimens were compared with type specimens from herbaria and or virtual online database, i.e. A, B, BKF, BM, BO, BR, C, E, K, KUN, KYO, L, LD, LE, LINN, M, MO, MICH, MPU, NY, P, PE, PH, PRC, RB, S, SBT, SING, TAI, TAIF, TI, U, UC, UKMB, US, and Z, to ensure the validity of species identification. The synonyms of each taxon were listed. The distribution of each species in Thailand was rewritten based on localities from herbarium specimens and taxonomic literatures. The world distribution was based on herbarium specimen labels and any taxonomic literatures from each species. Key-to-species and description of each species were constructed

and described based on Thai *Tectaria* specimens. Additional specimens collected from fieldworks were assembled at Prof. Kasin Suvatabhandhu Herbarium, Department of Botany, Faculty of Science, Chulalongkorn University (BCU).

### 3.2 Materials and methods for anatomical studies

#### 3.2.1 Materials and chemicals for anatomical studies

- 3.2.1.1 Automatic MT-3 microtome
- 3.2.1.2 Compound light microscope
- 3.2.1.3 Microscopic slides and cover glasses
- 3.2.1.4 Hot plate
- 3.2.1.5 Beakers
- 3.2.1.6 Petri dishes
- 3.2.1.7 Forceps
- 3.2.1.8 Droppers
- 3.2.1.9 Razor blades
- 3.2.1.10 Nail varnish
- 3.2.1.11 1% Safranin O
- 3.2.1.12 Distilled water
- 3.2.1.13 Plant materials

#### 3.2.2 Methodology for anatomical studies

##### 3.2.2.1 Study in vascular bundles arrangement in stipes

In this section, fresh and dry herbarium specimens of 39 species which have similar morphological characters were used (Table 3.1). The method of (Pongkai, 2011) as applied to this study. Firstly, stipes were cut into transverse section using Automatic MT-3 microtome (Toyozumi Dengeniki Co., Ltd.) without embedding in paraffin. Each stipe was cut into three segments (basal, middle, and terminal). Thickness of section was varied from 10-15 micrometers. If dry herbarium specimens were used, boiling was required. Portions of stipes were boiled in water to soften up, then they were soaked in cold water before cutting. Subsequently, the sections were stained with 1% Safranin O solution for 5-10 minutes. Then, a section was mounted on a clear glass slide, and covered with a thin glass coverslip. Finally, slides were viewed under a compound light microscope and a stereomicroscope.

##### 3.2.2.2 Study in stomata on epidermis

A modified method of Horanic and Gardner (1967) was used to study stomata on epidermis. First of all, a lamina of each specimens was cut into pieces of about 1 x 1 cm<sup>2</sup>. Then, hyaline nail varnish was coated on abaxial surface of each piece. When it dried, the replica of lamina epidermis were peeled off by using forcep. Then, the samples were stained using 1% Safranin O for 5-10 minutes and mounted. Finally, each samples were viewed under compound light microscope. Type of stomatal apparatus and terminology are according to Sen and De (1992).

### 3.3 Materials and methods for palynological study

#### 3.3.1 Materials and chemicals for palynological study

- 3.3.1.1 Compound light microscope
- 3.3.1.3 Microscopic slides and cover glasses
- 3.3.1.4 Petri dishes
- 3.3.1.5 Forceps
- 3.3.1.6 Needles
- 3.3.1.7 Distilled water
- 3.3.1.8 Plant materials

#### 3.3.2 Methodology for palynological study

Unacetylated spores from 39 *Tectaria* species (Table 3.2) were prepared and examined by compound light microscope. The morphological characters of spore were concentrated on shape, size and wall ornamentation. The size of spores was measured on both polar (P) and equatorial (E) axis. At least 5 spores per sample were counted. The spore ornamentation and definition were quoted from Lellinger and Taylor (1996); Tryon and Lugerdon (1990); Zhang et al. (1990), and Punt et al. (2007).



Table 3.1 *Tectaria* species used for anatomical study

No.	Species	Specimens
1	<i>Tectaria acrocarpa</i>	<i>T. Boonkerd</i> 1577N (BCU)
2	<i>Tectaria angulate</i>	<i>T. Boonkerd &amp; R. Pollawatn</i> 288 (BCU)
3	<i>Tectaria brachiata</i>	<i>S. Wongphakdee &amp; J. Ampornwatthanapong</i> 2016-10 (BCU)
4	<i>Tectaria coadunata</i>	<i>R. Pollawatn</i> 1588 (BCU)
5	<i>Tectaria crenata</i>	<i>T. Boonkerd</i> 1166 (BCU)
6	<i>Tectaria decurrens</i>	<i>S. Wongphakdee</i> 2015-2 (BCU)
7	<i>Tectaria devexa</i>	<i>T. Boonkerd, S. Chantanaorrapint &amp; W. Khwaiphan</i> 410 (BCU)
8	<i>Tectaria fauriei</i>	<i>P. Ratchata</i> 255 (BCU)
9	<i>Tectaria fuscipes</i>	<i>T. Boonkerd et al.</i> 2011-40 (BCU)
10	<i>Tectaria griffithii</i>	<i>Y. Yuyen</i> 44 (BCU)
11	<i>Tectaria gymnosora</i>	<i>Sirisak W.</i> 087 (BCU)
12	<i>Tectaria herpetocaulos</i>	<i>Sirisak W.</i> 060 (BCU)
13	<i>Tectaria impressa</i>	<i>Sirisak W.</i> 068 (BCU)
14	<i>Tectaria kehdingiana</i>	<i>P. Pongkai</i> 70 (BCU)
15	<i>Tectaria laotica</i>	<i>Sirisak W.</i> 010 (BCU)
16	<i>Tectaria manilensis</i>	<i>P. Klinratana et al.</i> 190 (BCU)
17	<i>Tectaria melanocaula</i>	<i>T. Boonkerd &amp; R. Pollawatn</i> 1479 (BCU)
18	<i>Tectaria multicaudata</i>	<i>R. Pollawatn</i> 2118 (BCU)
19	<i>Tectaria nayarii</i>	<i>T. Boonkerd, S. Chantanaorrapint &amp; W. Khwaiphan</i> 42 (BCU)
20	<i>Tectaria phaeocaulis</i>	<i>R. Pollawatn</i> 1777 (BCU)
21	<i>Tectaria phanomensis</i>	<i>T. Boonkerd, Y. Sirichamorn &amp; C. Sanguansub</i> 307 (BCU)
22	<i>Tectaria polymorpha</i>	<i>W. Rattanathirakul</i> 125 (BCU)
23	<i>Tectaria remotipinna</i>	<i>R. Pollawatn</i> 2150 (BCU)
24	<i>Tectaria rockii</i>	<i>S. Wongphakdee</i> 2015-1 (BCU)
25	<i>Tectaria sagenioides</i>	<i>A. Sathapattayanon</i> 129 (BCU)
26	<i>Tectaria semipinnata</i>	<i>T. Boonkerd, S. Chantanaorrapint &amp; W. Khwaiphan</i> 51 (BCU)
27	<i>Tectaria siifolia</i>	<i>T. Boonkerd, S. Chantanaorrapint &amp; W. Khwaiphan</i> 412 (BCU)
28	<i>Tectaria simonsii</i>	<i>W. Rattanathirakul</i> 102 (BCU)
29	<i>Tectaria singaporiana</i>	<i>T. Boonkerd, S. Chantanaorrapint &amp; W. Khwaiphan</i> 132 (BCU)
30	<i>Tectaria stenosemioides</i>	<i>T. Boonkerd et al.</i> 2011-566 (BCU)
31	<i>Tectaria subpedata</i>	<i>Sirisak W.</i> 003 (BCU)

No.	Species	Specimens
32	<i>Tectaria subvariolosa</i>	<i>R. Pollawatn</i> 1530 (BCU)
33	<i>Tectaria tenerifrons</i>	<i>T. Boonkerd et al.</i> 2011-408 (BCU)
34	<i>Tectaria vasta</i>	<i>T. Boonkerd</i> 1173 (BCU)
35	<i>Tectaria</i> sp.3	<i>T. Boonkerd et al.</i> 2011-416 (BCU)
36	<i>Tectaria</i> sp.4	<i>T. Boonkerd et al.</i> 2011-726 (BCU)
37	<i>Tectaria</i> sp.7	<i>T. Boonkerd et al.</i> 2011-629 (BCU)
38	<i>Tectaria</i> sp.8	<i>O. Ratana</i> 21 (BCU)
39	<i>Tectaria</i> sp.9	<i>T. Boonkerd et al.</i> 2011-535 (BCU)

Table 3.2 *Tectaria* species used for palynological study

No.	Species	Specimens
1	<i>Tectaria acrocarpa</i>	<i>T. Boonkerd</i> 1577N (BCU)
2	<i>Tectaria angulate</i>	<i>T. Boonkerd &amp; R. Pollawatn</i> 288 (BCU)
3	<i>Tectaria brachiata</i>	<i>S. Wongphakdee &amp; J. Ampornwatthanapong</i> 2016-10 (BCU)
4	<i>Tectaria coadunata</i>	<i>R. Pollawatn</i> 1588 (BCU)
5	<i>Tectaria crenata</i>	<i>T. Boonkerd</i> 1166 (BCU)
6	<i>Tectaria decurrens</i>	<i>S. Wongphakdee</i> 2015-2 (BCU)
7	<i>Tectaria devexa</i>	<i>T. Boonkerd, S. Chantanaorrapint &amp; W. Khwaiphan</i> 410 (BCU)
8	<i>Tectaria fauriei</i>	<i>P. Ratchata</i> 255 (BCU)
9	<i>Tectaria fuscipes</i>	<i>T. Boonkerd et al.</i> 2011-40 (BCU)
10	<i>Tectaria griffithii</i>	<i>Y. Yuyen</i> 44 (BCU)
11	<i>Tectaria gymnosora</i>	<i>Sirisak W.</i> 087 (BCU)
12	<i>Tectaria hennipmanii</i>	<i>E. Hennipman</i> 3060 (L)
13	<i>Tectaria herpetocaulos</i>	<i>Sirisak W.</i> 060 (BCU)
14	<i>Tectaria impressa</i>	<i>Sirisak W.</i> 068 (BCU)
15	<i>Tectaria kehdingiana</i>	<i>P. Pongkai</i> 70 (BCU)
16	<i>Tectaria laotica</i>	<i>Sirisak W.</i> 010 (BCU)
17	<i>Tectaria manilensis</i>	<i>T. Boonkerd et al.</i> 2011-609 (BCU)
18	<i>Tectaria melanocaula</i>	<i>T. Boonkerd &amp; R. Pollawatn</i> 1479 (BCU)
19	<i>Tectaria multicaudata</i>	<i>R. Pollawatn</i> 2118 (BCU)
20	<i>Tectaria nayarii</i>	<i>T. Boonkerd, S. Chantanaorrapint &amp; W. Khwaiphan</i> 42 (BCU)
21	<i>Tectaria phaeocaulis</i>	<i>A. Sathapattayanon</i> 488 (BCU)
22	<i>Tectaria phanomensis</i>	<i>T. Boonkerd, Y. Sirichamorn &amp; C. Sanguansub</i> 307 (BCU)
23	<i>Tectaria polymorpha</i>	<i>W. Rattanathirakul</i> 125 (BCU)
24	<i>Tectaria remotipinna</i>	<i>R. Pollawatn</i> 2150 (BCU)
25	<i>Tectaria rockii</i>	<i>S. Wongphakdee</i> 2015-1 (BCU)

No.	Species	Specimens
26	<i>Tectaria sagenioides</i>	A. Sathapattayanon 129 (BCU)
27	<i>Tectaria semipinnata</i>	T. Boonkerd, S. Chantanaorrapint & W. Khwaiphan 51 (BCU)
28	<i>Tectaria simonsii</i>	W. Rattanathirakul 102 (BCU)
29	<i>Tectaria singaporiana</i>	T. Boonkerd, S. Chantanaorrapint & W. Khwaiphan 132 (BCU)
30	<i>Tectaria stenosemioides</i>	T. Boonkerd et al. 2011-566 (BCU)
31	<i>Tectaria subpedata</i>	Sirisak W. 003 (BCU)
32	<i>Tectaria subvariolosa</i>	R. Pollawatn 1530 (BCU)
33	<i>Tectaria tenerifrons</i>	T. Boonkerd et al. 2011-408 (BCU)
34	<i>Tectaria vasta</i>	T. Boonkerd 1173 (BCU)
35	<i>Tectaria</i> sp.3	T. Boonkerd et al. 2011-416 (BCU)
36	<i>Tectaria</i> sp.4	T. Boonkerd et al. 2011-726 (BCU)
37	<i>Tectaria</i> sp.7	T. Boonkerd et al. 2011-629 (BCU)
38	<i>Tectaria</i> sp.8	O. Ratana 21 (BCU)
39	<i>Tectaria</i> sp.9	T. Boonkerd et al. 2011-535 (BCU)



## CHAPTER IV

### TAXONOMIC TREATMENT

Fifty four Thai *Tectaria* were enumerated (Table 4.1). Eleven new records and nine new species were reported. Keys, descriptions, distribution in Thailand, ecology and distribution map in Thailand were amended or reconstructed from the previous records in the Flora of Thailand (Tagawa and Iwatsuki, 1988). photographs were prepared.

Table 4.1 Check list of *Tectaria* in Thailand

No.	Species	Note
1.	<i>Tectaria acrocarpa</i> (Ching) Christenh.	New record; only one collection from Thailand and the second record from this study.
2.	<i>Tectaria angulata</i> (Willd.) Copel.	
3.	<i>Tectaria aurita</i> (Sw.) S. Chandra	New record; only one collection from Thailand and the first report from Mainland in SE Asia.
4.	<i>Tectaria barberi</i> (Hook.) Copel.	
5.	<i>Tectaria brachiata</i> (Zoll. & Moritzi) C. V. Morton	
6.	<i>Tectaria chattagramica</i> (C. B. Clarke) Ching	New record
7.	<i>Tectaria coadunata</i> (Wall. ex Hook. & Grev.) C. Chr.	
8.	<i>Tectaria crenata</i> Cav.	
9.	<i>Tectaria decurrens</i> (C. Presl) Copel.	
10.	<i>Tectaria devexa</i> (Kunze) Copel.	
11.	<i>Tectaria fauriei</i> Tagawa	
12.	<i>Tectaria fissa</i> (Kunze) Holttum	
13.	<i>Tectaria fuscipes</i> (Wall. ex Bedd.) C. Chr.	
14.	<i>Tectaria griffithii</i> (Baker) C. Chr.	
15.	<i>Tectaria gymnosora</i> Holttum	
16.	<i>Tectaria hennipmanii</i> (Tagawa & K. Iwats.) S. Y. Dong	Endemic
17.	<i>Tectaria herpetocaulos</i> Holttum	
18.	<i>Tectaria hymenophylla</i> (Parish ex Bedd.) Holttum	New record
19.	<i>Tectaria impressa</i> (Fée) Holttum	

No.	Species	Note
20.	<i>Tectaria keckii</i> (Luerss.) C. Chr.	
21.	<i>Tectaria kehdingiana</i> (Kuhn) M. G. Price	New record
22.	<i>Tectaria laotica</i> Tardieu & C. Chr.	
23.	<i>Tectaria manilensis</i> (C. Presl) Holttum	
24.	<i>Tectaria melanocaula</i> (Blume) Copel.	New valid name (Holttum, 1986)
25.	<i>Tectaria multicaudata</i> (C. B. Clarke) Ching	New record; new determination from <i>T. griffithii</i> (Baker) C. Chr.
26.	<i>Tectaria nayarii</i> Mazumdar	
27.	<i>Tectaria phaeocaulis</i> (Rosenst.) C. Chr.	
28.	<i>Tectaria phanomensis</i> S. Linds.	Endemic
29.	<i>Tectaria poilanei</i> Tardieu	New record
30.	<i>Tectaria polymorpha</i> (Wall. ex Hook.) Copel.	
31.	<i>Tectaria remotipinna</i> Ching & Chu H. Wang	
32.	<i>Tectaria rockii</i> C. Chr.	
33.	<i>Tectaria sagenioides</i> (Mett.) Christenh.	
34.	<i>Tectaria semipinnata</i> (Roxb.) C. V. Morton	
35.	<i>Tectaria siifolia</i> (Willd.) Copel.	
36.	<i>Tectaria simonsii</i> (Baker) Ching	
37.	<i>Tectaria singaporiana</i> (Wall. ex Hook. & Grev.) Copel.	New valid name (Copeland, 1917)
38.	<i>Tectaria stenosemioides</i> (Alderw.) C. Chr.	
39.	<i>Tectaria subpedata</i> (Harr.) Ching	New record
40.	<i>Tectaria subvariolosa</i> S. Y. Dong	New record
41.	<i>Tectaria tenerifrons</i> (Hook.) Ching	
42.	<i>Tectaria trichotoma</i> (Fée) Tagawa	New record
43.	<i>Tectaria vasta</i> (Blume) Copel.	
44.	<i>Tectaria zeilanica</i> (Houtt.) Sledge	
45.	<i>Tectaria zippelii</i> S.Y. Dong	New record
46.	<i>Tectaria</i> sp.1	Proposed new species; endemic; only one specimens from Tham Wang Phraya Pichai Songkhram, Russada district, Trang province
47.	<i>Tectaria</i> sp.2	Proposed new species; endemic; only

No.	Species	Note
		one specimens from Kaeng Krachan National Park, Kaeng Krachan district, Phetchaburi province
48.	<i>Tectaria</i> sp.3	Proposed new species; endemic; only two specimens from Khao Chakan Arboretum, Khao Chakan district, Sakaeo province
49.	<i>Tectaria</i> sp.4	Proposed new species; endemic; only one specimens from Tham Nam Wang Si Thammasokarat, Lansaka district, Nakhon Si Thammarat province
50.	<i>Tectaria</i> sp.5	Proposed new species; endemic; only one specimens from Khao Chong, Trang province
51.	<i>Tectaria</i> sp.6	Proposed new species; endemic; only one specimens at along roadside from Nam Nao - Chumphae, Nam Nao National Park, Phetchabun province
52.	<i>Tectaria</i> sp.7	Proposed new species; endemic; only two specimens from Nong Hin district, Loei province
53.	<i>Tectaria</i> sp.8	Proposed new species; endemic; only two specimens from two locality, i.e. Sunantha Falls, Khao Nan National Park, Nopphitum district, Nakhon Si Thammarat province, and Waeng district, Narathiwat province
54.	<i>Tectaria</i> sp.9	Proposed new species; endemic; only one specimen from Bodhisattva Cave, Nong Hin district, Loei province

- Tectaria* Cav.**, Anales Hist. Nat. 1(2): 115. 1799; Descr. Pl. (Cavanilles): 249. 1802; Underw., Bull. Torr. Club 33: 199. 1906; Copel., Philipp. J. Sci., C 2: 415. 1907; Maxon, Contr. U.S. Nat. Herb. 10: 494. 1908; Alderw., Bull. Dept. Agric. Ind. Neerl. 18: 9. 1908; Copel., Philipp. J. Sci., C 6: 76. 1911; Leaf. Philipp. Bot. 4: 1,151. 1911; Copel., Philipp. J. Sci., C 9: 228. 1914; Copel., Philipp. J. Sci., C 10: 146. 1915; Ching, Sinensia 2: 9. 1931; Backer & Posth., Varenfl. Jav.: 71. 1939; Tardieu & C. Chr., Fl. Indo-Chine 7(2): 402. 1941; Holttum, Rev. Fl. Malaya ed. 1, 2: 501. 1955 ['1954']; Gen. Fil. [Copeland]: 128. 1947; C.E. DeVol & C.M. Kuo, Fl. Taiwan 1:341. 1975; Brownlie, Pterid. Fl. Fiji: 286. 1977; D.L. Jones & Clemesha, Austral. Fern & Fern Allies ed. 2: 206. 1980; Schelpe & N.C. Anthony, Fl. S. Africa [ed. L.E.W. Codd et al.]: 265. 1986; Tagawa & K. Iwats., Fl. Thailand 3(3): 364. 1988; Goudey, Handb. Fern Austral. & New Zealand: 169. 1989; Proctor, 1989; Mem. New York Bot. Gard. 53: 250. 1989; K.U. Kramer & P.S. Green, Fam. Gen. Vasc. Pl. [Kubitzki] 1: 119. 1990; Holttum, Fl. Males. Ser. 2 Pterid. 2: 39. 1991; J.L. Tsai & W.C. Shieh, Fl. Taiwan ed. 2: 296. 1994; Bostock, Fl. Australia 48: online. 1998; Khullar, Ill. Fern Fl. W Himalaya 2: 431. 2000; Subh. Chandra, The Ferns of India: 222. 2000; Borthakur, P. Deka & K.K. Nath, Illustrated manual of ferns of Assam: 375. 2001; D.D. Palmer, Hawaii Fern & Fern Allies: 247. 2003; Smith et al., Taxon 55(3): 718. 2006; Zink in Dassanayake, Revis. Handb. Fl. Ceylon [Dassanayake] 15(A): 158. 2006; Mabb., Mabblerley's Pl.-Book: 844. 2008; Christenh., X.C. Zhang & H. Schneid., Phytotaxa 19: 11, 39. 2011; F.W. Xing, Y.H. Yan, S.Y. Dong, F.G. Wang, Christenh. & Hovenkamp, Fl. China 2–3: 733. 2013. Type: *Tectaria trifoliata* (L.) Cav.
- Aspidium* Sw., J. Bot. (Schrader) 1800(2): 4, 29. 1802, *nom. superfl.*; C. Presl, Tent. Pterid.: 87. 1836; Bedd., Handb. Ferns Brit. India: 212. 1883; Nakai, Bot. Mag. (Tokyo) 47(555): 155. 1933; Ching, Bull. Fan Mem. Inst. Biol., Bot. 10(5): 235–236. 1941. Type: *Aspidium trifoliatum* (L.) Sw.
- Amphiblestra* C. Presl; Tent. Pterid.:150. 1836. Type: *Amphiblestra latifolia* (Willd.) C. Presl.
- Dictyopteris* C. Presl, Tent. Pterid.: 194. 1836, *nom illeg. hom.*; Bedd., Handb. Ferns Brit. India: 298. 1883; Nakai, Bot. Mag. (Tokyo) 47(555): 158–159. 1933. Type: *Dictyopteris irregularis* (C. Presl) C. Presl.
- Sagenia* C. Presl, Tent. Pterid.: 86–87, pl. 2, f. 22–25. 1836; Nakai, Bot. Mag. (Tokyo) 47(555): 164–165. 1933. Type: *Sagenia latifolia* C. Presl.
- Stenosemia* C. Presl, Tent. Pterid.: 237. 1836; Backer & Posth., Varenfl. Jav.: 71. 1939; Type: *Stenosemia aurita* (Sw.) C. Presl.
- Fadyenia* Hook., Gen. Fil. (Hooker): t. 53, 1840. Type: *Fadyenia prolifera* Hook.
- Bathmium* C. Presl ex Link, Fil. Spec.: 99, 114. 1841, *nom. superfl.* Type: *Bathmium trifoliatum* (L.) Link.
- Heterogonium* C. Presl, Abh. Königl. Böhm. Ges. Wiss., ser. 5, 6: 502–503. 1851; Copel., Gen. Fil. [Copeland]: 127. 1947; Sarawak Mus. J. 5: 160. 1949; Holttum, Rev. Fl. Malaya ed. 1, 2: 519. 1955 ['1954']; Kalikasan 4: 205. 1975; Tagawa & K. Iwats., Fl. Thailand 3(3): 360. 1988; K.U. Kramer & P.S. Green, Fam. Gen. Vasc. Pl. [Kubitzki] 1: 122. 1990; Holttum, Fl. Males. Ser. 2 Pterid. 2: 105. 1991. Type: *Heterogonium aspidioides* C. Presl.

- Microbrochis* C. Presl, Epim. Bot. 51. 1851; Abh. Königl. Böhm. Ges. Wiss., ser. 5, 6: 411–412. 1851. Type: *Microbrochis apiifolia* (Schkuhr) C. Presl.
- Polydictyum* C. Presl; Epim. Bot.: 52. 1851. Type: *Polydictyum menyanthidis* (C. Presl) C. Presl.
- Psomiocarpa* C. Presl, Abh. Königl. Böhm. Ges. Wiss., ser. 5, 6: 521. 1851; K.U. Kramer & P.S. Green, Fam. Gen. Vasc. Pl. [Kubitzki] 1: 123. 1990; Holttum, Fl. Males. Ser. 2 Pterid. 2: 100. 1991. Type: *Psomiocarpa apiifolia* (J. Sm.) C. Presl.
- Camptodium* Fée; Mem. Mém. Foug. 5: 298. 1852. Type: *Camptodium pedatum* (Desv.) Fée
- Lastrea* sect. *Camptodium* (Fée) T. Moore, Index Filic.: 88. 1857. Type: as for *Camptodium*.
- Cardiochlaena* Fée; Mém. Foug. 5: 314–315. 1852. Type: *Cardiochlaena menyanthidis* (C. Presl) Fée.
- Sagenia* sect. *Cardiochlaena* (Fée) T. Moore, Index Filic.: 86. 1857. Type: as for *Cardiochlaena*.
- Cionidium* T. Moore, Gard. Companion Florists' Guide 1852: 143. 1852. Type: *Cionidium moorii* T. Moore.
- Deparia* sect. *Trichiocarpa* Hook., Hooker's J. Bot. Kew Gard. Misc. 4: 55. 1852, *nom. superfl.* Type: as for *Cionidium*.
- Trichiocarpa* (Hook.) J. Sm., Cat. Ferns Gard. Kew: 7. 1856, *nom. superfl.* Type: as for *Cionidium*.
- Dryomenis* Fée; Mém. Foug. 5: 225. 1852; Seemann, Bot. Voy. Herald: 229. 1857; Nakai, Bot. Mag. (Tokyo) 47(555): 159–160. 1933. Type: *Dryomenis menisciicarpon* (J. Sm.) T. Moore.
- Phlebiogonium* Fée, Mém. Foug 5: 314. 1852. Type: *Phlebiogonium impressum* Fée.
- Podopeltis* Fée, Mém. Foug 5: 286. 1852. Type: *Podopeltis singaporiana* (Wall. ex Hook. & Grev.) Fée.
- Grammatosorus* Regel, Gartenflora 15: 336. 1866; Index Sem. (St. Petersburg) 1866: 75. 1866. Type: *Grammatosorus blumeanus* Regel.
- Luerssenia* Kuhn in Luerss., Bot. Centralbl. 11: 77. 1882. Type: *Luerssenia kehdingiana* Kuhn.
- Hemigramma* Christ; Bull. Herb. Boissier 2, 6: 1006. 1906; Philipp. J. Sci., C 2(3): 170. 1907; Backer & Posth., Varenfl. Jav.: 78. 1939; Tardieu & C. Chr., Fl. Indo-Chine 9: 438. 1941; J.L. Tsai & W.C. Shieh, Fl. Taiwan ed. 2: 288. 1994. Type: *Hemigramma zollingeri* (Kurz) Christ.
- Tectaridium* Copel., Philipp. J. Sci. 30: 329. 1926; Holttum, Fl. Males. Ser. 2 Pterid. 2: 36. 1991. Type: *Tectaridium macleanii* Copel.
- Quercifilix* Copel.; Philipp. J. Sci., C 37(4): 408. 1928; Tardieu & C. Chr., Fl. Indo-Chine 9: 440. 1941; Tagawa & K. Iwats., Fl. Thailand 3(3): xx. 1988; J.L. Tsai & W.C. Shieh, Fl. Taiwan ed. 2: 294. 1994. Type: *Quercifilix zeylanica* (Houtt.) Copel.
- Lenda* Koidz., Acta Phytotax. Geobot. 5: 142. 1936. Type: *Lenda subtriphyllo* (Hook. & Arn.) Koidz.
- Ctenitopsis* Ching ex Tardieu & C. Chr., Notul. Syst. (Paris) 7(2): 86. 1938; Ching, Bull. Fan Mem. Inst. Biol. Bot. 8(4): 304–305. 1938; Tardieu & C. Chr., Fl.

Indo-Chine 7(2): 347. 1941; J.L. Tsai & W.C. Shieh, Fl. Taiwan ed. 2: 284. 1994. Type: *Ctenitopsis sagenioides* (Mett.) Ching.

*Pseudotectaria* Tardieu-Blot; Notul. Syst. (Paris) 15: 87. 1955. Type: *Pseudotectaria decaryana* (C. Chr.) Tardieu.

*Plant* small to rather large, terrestrial or epilithic. *Rhizome* erect, ascending or creeping, bearing densely scales at apex; *scales* basifixed, concolorous or bicolored, stramineous to nearly black, usually lanceolate, apex acuminate, margin entire to hairy. *Fronde*s monomorphic or dimorphic; stipes stramineous to nearly black, usually grooved, covered with a few short hairs throughout, usually scaly at base or sometimes throughout; lamina simple to pinnately compound, ovate-subdeltoid or elliptic-oblong in outline, margin entire, pinnatifid to deeply lobed, basal pinnae often having the longest basal basisopic lobes, sometimes shorten or none, chartaceous to subcoriaceous; veins all free to fully anastomosing forming areoles with or without free included veinlets, veinlets simple, forked or branched. *Sori* usually round, sometimes elongate or acrostichoid, located on terminal free veins or veinlets or dorsal on anastomosing veins, rarely elongate only at sinuses near margin and margin reflexed, indusiate or exindusiate; indusia if present round-reniform, persistent or caducous. Spores ellipsoid, ovoid or subspheroidal, perispore verrucate, rugulate or echinate.

A genus comprises about 150–210 species, pantropic in distribution. Fifty four species in Thailand of which 11 endemic: *Tectaria hennipmanii* (Tagawa & K. Iwats.) S.Y. Dong, *Tectaria phanomensis* S. Linds., *Tectaria* sp.1, *Tectaria* sp.2, *Tectaria* sp.3, *Tectaria* sp.4, *Tectaria* sp.5, *Tectaria* sp.6, *Tectaria* sp.7, *Tectaria* sp.8, and *Tectaria* sp.9. The genus and species descriptions have been mainly taken from Thai material and may, therefore, not apply outside this country.

### Key to the species

(Based mainly on reproductive traits)

- 1a Fertile fronds simple, margin of lamina entire or parted to pinnatifid.....2  
 1b Fertile fronds trifoliate or pinnately compound, margin of lamina entire  
 or lobed.....8  
 2a Margin of lamina unlobed.....3  
 2b Margin of lamina lobed.....5  
 3a Sori round, indusiate.....4  
 3b Sori usually confluent, exindusiate.....53. *T. sp.8*  
 4a Sori terminal on veinlets, covered throughout abaxially, rather deeply impressed  
 on abaxial surface of lamina; fronds distinctly dimorphic.....21. *T. kehdingiana*  
 4b Sori dorsal on anastomosing veins, arranged in 2 rows between adjacent cross  
 veins and 4–5 rows between main veins; fronds monomorphic or slightly  
 dimorphic.....37. *T. singaporiana*  
 5a Margin of lamina palmately 3-parted, stipes not winged.....39. *T. subpedata*  
 5b Margin of lamina pinnatifid, stipes winged.....6  
 6a Sori terminal on veinlets, arranged in 2 regular rows between main veins, rather  
 deeply impressed on abaxial surface of lamina.....9. *T. decurrens*  
 6b Sori dorsal on anastomosing veins, arranged in 3-6 irregular rows between main  
 veins.....7

7a Winged of stipe up to 0.5 cm wide, gradually narrowing from apex towards base; proliferous usually present on rachis; .....	11. <i>T. fauriei</i>
7b Winged of stipe 0.6–1.0 cm wide, equally from apex towards base; proliferous absent on rachis; .....	43. <i>T. vasta</i>
8a Sori acrostichoid.....	9
8b Sori not acrostichoid.....	11
9a Fronds trifoliate or rarely quinquefoliate; rhizome creeping.....	44. <i>T. zeilanica</i>
9b Fronds pinnately compound, lamina bipinnatifid; rhizome erect.....	10
10a Basal basisopic lobe of basal pinnae the longest.....	3. <i>T. aurita</i>
10b Basal basisopic lobe of basal pinnae shortened.....	26. <i>T. nayarii</i>
11a Veins all free, or partly anastomosing to form costal areoles only.....	12
11b Veins anastomosing to form areoles outside the costal and costular areoles ones.....	23
12a Lamina oblong-elliptic in outline.....	13
12b Lamina ovate-subdeltoid in outline.....	16
13a Basal basisopic lobe of basal pinnae the longest.....	14
13b Basal basisopic lobe of basal pinnae shortened.....	15
14a Sori only at apical lobes; veins all free; scales light brown to castaneous with paler ferrugeneous margin; perispore without spine.....	1. <i>T. acrocarpa</i>
14b Sori cover throughout abaxially; veins all free or more or less anastomosing; scales dark brown to nearly black with narrowly paler edge; perispore with spine.....	13. <i>T. fuscipes</i>
15a Scales concolorous, light brown; fronds slightly dimorphic.....	16. <i>T. hennipmanii</i>
15b Scales bicolored, dark brown at central portion with paler edge; fronds monomorphic.....	33. <i>T. sagenioides</i>
16a Sori exindusiate.....	17
16b Sori indusiate.....	18
17a Sori elongate only at sinuses near margin and margin reflexed.....	49. <i>T. sp.4</i>
17b Sori round, compital on free veinlets.....	28. <i>T. phanomensis</i>
18a Veins all free.....	19
18b Veins partly anastomosing, forming costal areoles.....	21
19a Fronds herbaceous; pinnae up to 4 pairs.....	20
19b Fronds chartaceous; pinnae more than 6 pairs.....	42. <i>T. trichotoma</i>
20a Sori near apices of pinna-lobes; very few thick hairs between veins on upper surface present.....	18. <i>T. hymenophylla</i>
20b Sori not near apices of pinna-lobes; many thick hairs between veins on upper surface present .....	23. <i>T. manilensis</i>
21a Basal basisopic lobe of basal pinnae the longest; scales concolorous.....	22
21b Basal basisopic lobe of basal pinnae shortened; scales bicolored.....	38. <i>T. stenosemioides</i>
22a Fronds monomorphic, covering with a few short hairs on stipe, rachis, midrib and main veins.....	10. <i>T. devexa</i>
22b Fronds slightly dimorphic, covering with densely hairs throughout on stipe, rachis, lamina, midrib and main veins.....	48. <i>T. sp.3</i>
23a Sori terminal on free veinlets only.....	24
23b Sori usually dorsal on anastomosing veins, or both on terminal veinlets and on anastomosing veins.....	38

24a	Veinlets in costal areoles absent.....	25
24b	Veinlets in costal areoles present.....	33
25a	Rhizome erect to ascending.....	26
25b	Rhizome creeping.....	30
26a	Fronds usually more than 60 cm long.....	27
26b	Fronds usually up to 50 cm long.....	28
27a	Rhizome and stipe base with blunt spines; stipe scaly at base; ..	31. <i>T. remotipinna</i>
27b	Rhizome and stipe without spines; stipes scaly throughout.....	25. <i>T. multicaudata</i>
28a	Fronds bipinnate.....	51. <i>T. sp.6</i>
28b	Fronds bipinnatifid.....	29
29a	Basal basisopic lobes the longest; Fronds dimorphic, lamina glabrous except a few short hairs on midrib or main veins beneath; veins conspicuous.....	6. <i>T. chattagramica</i>
29b	Basal basisopic lobes shortened; Fronds monomorphic, lamina pubescent; veins inconspicuous.....	46. <i>T. sp.1</i>
30a	Fronds monomorphic.....	31
30b	Fronds dimorphic.....	32
31a	Scale margin fimbriate; base of lateral pinnae unequally cuneate.....	52. <i>T. sp.7</i>
31b	Scale margin entire; base of lateral pinnae round.....	7. <i>T. coadunata</i>
32a	Fronds hairy on upper surface; lateral pinnae 1 pair.....	40. <i>T. subvariolosa</i>
32b	Fronds glabrous, or with a few hairs near sinus only; lateral 2-4 pairs.....	19. <i>T. impressa</i>
33a	Basal pinnae margin deeply lobed or pinnate.....	34
33b	Basal pinnae margin mostly entire or crenate.....	37
34a	Rhizome erect or ascending.....	35
34b	Rhizome creeping.....	36
35a	Stipes scaly throughout; fronds monomorphic, lamina of fertile fronds up to 200 × 100 cm.....	14. <i>T. griffithii</i>
35b	Stipes scaly at base; fronds dimorphic, lamina of fertile fronds up to 20 × 15 cm.....	5. <i>T. brachiata</i>
36a	Fronds slightly dimorphic; scales lanceolate, 2-3 mm long.....	54. <i>T. sp.9</i>
36b	Fronds monomorphic; scales linear-subtriangular, 4-6 mm long.....	27. <i>T. phaeocaulis</i>
37a	Sori arranged in two rows between main veins, only one sori in each areoles.....	8. <i>T. crenata</i>
37b	Sori scattered irregularly, usually more than one in each areoles.....	2. <i>T. angulata</i>
38a	Sori usually confluent, indusia absent.....	34. <i>T. semipinnata</i>
38b	Sori usually round, indusia present, usually caducous.....	39
39a	Terminal pinnae lanceolate or elliptic, similar to lateral pinnae below.....	40
39b	Terminal pinnae pinnatifid, different from lateral pinnae below.....	46
40a	Rhizome creeping.....	17. <i>T. herpetocaulos</i>
40b	Rhizome erect or suberect to ascending.....	41
41a	Fronds dimorphic, trifoliolate to quinquefoliate; proliferous often present at junction of rachis and costa.....	35. <i>T. siifolia</i>
41b	Fronds monomorphic, pinnately compound, more than two pairs of free lateral pinnae; proliferous absent.....	42



- 42a Sori mostly confined near margin; lateral pinnae crenate to shallowly lobed.....22. *T. laotica*
- 42b Sori scattered throughout; lateral pinnae entire.....43
- 43a Rachis winged, gradually narrow from apex towards base; sori exindusiate.....15. *T. gymnosora*
- 43b Rachis not winged; sori indusiate.....44
- 44a Lateral pinnae up to 3.0 cm wide, lanceolate, base cuneate.....12. *T. fissa*
- 44b Lateral pinnae more than 4.0 cm wide, usually elliptic, base round.....45
- 45a Sori arranged in irregular 3–4 rows between main veins; costal areoles indistinct.....30. *T. polymorpha*
- 45b Sori arranged in regular 2 zig-zag rows between main veins; costal areoles distinct.....29. *T. poilanei*
- 46a Lateral pinnae entire to shallowly lobed.....4. *T. barberi*
- 46b Lateral pinnae deeply lobed or pinnate.....47
- 47a Stipes stramineous to dark brown.....48
- 47b Stipes purplish to nearly black.....51
- 48a Fronds herbaceous; rhizome creeping.....41. *T. tenerifrons*
- 48b Fronds papyraceous to subcoriaceous; rhizome erect to ascending.....49
- 49a Free veinlets in areoles absent; sori exindusiate.....47. *T. sp.2*
- 49b Free veinlets in areoles present; sori indusiate.....50
- 50a Sori mostly confined near margin; fronds up to 2 m long, bipinnatifid to quadripinnatifid at base; stipes stramineous to light brown adaxially, deeper brown abaxially.....32. *T. rockii*
- 50b Sori scattered throughout; fronds up to 1 m long, bipinnate at base; stipe castaneous to dark brown on both adaxially and abaxially.....20. *T. keckii*
- 51a Sori terminal on free included veinlets; scales bicolored, deep purplish-brown with paler margin; lateral pinnae deeply lobed.....24. *T. melanocaula*
- 51b Sori dorsal on anastomosing veins; scales concolorous, dark brown; lateral pinnae entire to slightly crenate.....36. *T. simonsii*

1. *Tectaria acrocarpa* (Ching) Christenh., Phytotaxa 10: 58. 2010; F.W. Xing, Y.H. Yan, S.Y. Dong, F.G. Wang, Christenh. & Hovenkamp, Fl. China 2–3: 734, f. 1007, 1–2. 2013. Type: China, Yunnan, Jinping, 500 m, 16 Aug. 1962, S.K. Wu 3985 [holotype PE! (photo seen PE00044726), isotype PE! (photo seen PE00044727), paratype, S.K. Wu 3971 PE! (photo seen PE01397512)].

*Ctenitopsis acrocarpa* Ching, Acta Phytotax. Sin. 19(1): 124. 1981. Type: as for above.

*Rhizome* short, erect; *scales* basifixed, bicolored, castaneous centrally with paler brown ferruginous margin,  $3\text{--}7 \times 1\text{--}3$  mm, lanceolate, apex acuminate, margin minutely toothed. *Fronds* slightly dimorphic, fertile fronds and sterile fronds usually similar in shape but fertile fronds often smaller than sterile ones, lamina bipinnatifid; stipes dull dark stramineous, grooved adaxially, up to 40 cm long in sterile fronds and up to 30 cm long in fertile fronds, covered with short hairs, scaly at base; lamina oblong-elliptic,  $46.0 \times 21.0$  cm in sterile fronds and  $28.0\text{--}31.0 \times 17.0\text{--}19.0$  cm in fertile fronds; basal pinnae  $14.0 \times 10.0$  cm in sterile fronds and  $12.0 \times 8.0$  cm in fertile fronds, ovate-triangular in outline, deeply lobed; basal pinnule  $9.5 \times 2.5$  cm in sterile fronds and  $8.5\text{--}9.5 \times 1.3\text{--}1.5$  cm in fertile fronds, lanceolate-elliptic, apex

acuminate, base cuneate, margin pinnatifid to 1/2 towards costule, lobes ovate-subtriangular, apex acute, margin entire, terminal pinnule 14.5 × 5.0 cm in sterile fronds and 10.5 × 4.5 cm in fertile fronds, lanceolate-elliptic, apex acute, margin pinnatifid to 1/2–2/3 towards costule, lobes lanceolate-oblong, slightly falcate, apex acute, margin entire, basiscopic lobes longer than acroscopic lobes; lateral pinnae 6–8 pairs, 11.5–20.0 × 2.0–2.5 cm in sterile fronds and 8.5–13.0 × 1.5–2.0 cm in fertile fronds, alternate, sessile to shortly stalked, linear-lanceolate, apex acuminate, base round to slightly cuneate, margin pinnatifid to 1/2 towards costa, lobes oblong, apex acute, margin entire; terminal pinna pinnatifid, 15.0 × 16.0 cm in sterile fronds and 8.0 × 10.0 cm in fertile fronds, broadly ovate-deltoid, apex acuminate, base cuneate, margin deeply lobed to 4/5 towards costa, lobes lanceolate-falcate, apex acuminate, margin crenate to shallowly lobed; texture chartaceous, glabrous on both surfaces except few short hairs on sinus, midrib and main veins both adaxially and abaxially, veins all free, forked. *Sori* round, terminal on veinlets at apical lobes, arranged in two rows between main veins; indusia round-reniform, stiff, persistent.

**Fig. 4.1.**

Thailand.— NORTHERN: Nan (Doi Phu Kha National Park).

Distribution.— China [Yunnan (type)].

Ecology.— Terrestrial on hill slope in shady places in lower montane forest at 1,300 m alt.

Note.— Similar to *T. fuscipes* (Wall. ex Bedd.) C. Chr. but differing in its venation and sori. Based on Thai specimens, *T. acrocarpa* has totally free veins whereas Chinese specimens perhaps have free or some anastomosing veins forming angular areoles. Sori are terminal on veinlets at apical lobes.

Specimens examined.— **THAILAND:** Nan, Doi Phu Kha National Park, 1 Mar. 1996, *T. Boonkerd* 1577 (BCU).

**CHINA: Yunnan,** *S. K. Wu* 3971 (PE), *S. K. Wu* 3985 (PE).

**2. *Tectaria angulata*** (Willd.) Copel., Sarawak Mus. J. 2: 370. 1917; Backer & Posth., Varenfl. Java: 74. 1939; Holttum, Rev. Fl. Malaya ed. 1, 2: 511, f. 301. 1955 [‘1954’], excl. syn. *Nephrodium nebulosum* Baker; Tagawa & K. Iwats., S. E. Asian Stud. 3(3): 86. 1965; Acta Phytotax. Geobot. 23: 55. 1968; A. Johnson, A Student’s Guide to the Ferns of Singapore Island: 83. 1977; Tagawa & K. Iwats., Fl. Thailand 3(3): 373, f. 34.3. 1988; Holttum, Fl. Males., Ser. 2, Pterid. 2: 85. 1991; I.M. Turner, Gard. Bull. Singapore 47(1): 53. 1995; Bidin & Jaman, ASEAN Rev. Biodivers. Environm. Conservation: 8. 1999; Boonkerd & Pollawatn, Pterid. Thailand: 211. 2000; S. Linds., D.J. Middleton, Boonkerd & Suddee, Thai For. Bull., Bot. 37: 98. 2009; Wardani & Jaenudin, Proc. Int. Conf. Resource Conservation: 182. 2013. Type: Java, *Ventenat* s.n. [holotype B! (B-W 19641-01 0), photo BM!].

*Polypodium angulatum* Willd., Sp. Pl. 5: 185. 1810. Type: as for above.

*Aspidium angulatum* (Willd.) J. Sm. ex Mett., Ann. Mus. Bot. Lugduno-Batavi 1: 239. 1864; Bedd., Suppl. Ferns British India: 45. 1892; Alderw., Malayan Ferns: 236. 1908. Type: as for *P. angulatum*.

*Aspidium sanctum* Blume, Enum. Pl. Javae: 143. 1828. Type: Java, *Blume* s.n. [holotype L! (photo seen L 0052144), photos BM!, P! (photo seen)].

- Dictyopteris pentaphylla* Alderw., Bull. Dép. Agric. Ind. Néerl. 18: 16. 1908; Malayan Ferns: 519. 1908. Type: New Guinea, *Treub* 232 [holotype BO, isotypes K! (K000360875), L! (photo seen L 0052146)].
- Aspidium quinquefoliolatum* C. Chr., Index Filic., Suppl. (1906-1912): 9. 1913, not *A. pentaphyllum* Willd., *nom. nov.* Type: as for *D. pentaphylla*.
- Tectaria pentaphylla* (Alderw.) C. Chr., Index Filic., Suppl. Tertium pro Annis 1917-1933: 183. 1934. Type: as for *D. pentaphylla*.
- Aspidium trifolium* Alderw., Bull. Jard. Bot. Buitenzorg 7: 4. 1912; Malayan Ferns Suppl.: 193. 1917, excl. var. *compitale*. Type: Philippines, Luzon, A. D. E. Elmer 8329 [holotype BO, isotypes K! (K000360206), L! (photo seen L 0052145), P! (photo seen P01486797)].
- Tectaria trifolia* (Alderw.) C. Chr., Bot. Jahrb. Syst. 66: 49. 1934; Copel., Fern Fl. Philipp.: 307, *pro parte*. 1960. Type: as for *A. trifolium*.
- Aspidium terminale* Rosenst., Meded. Rijks-Herb.31: 4. 1917; C. Chr., Gard. Bull. Straits Settlem. 4: 393. 1929. Type: Borneo, *Halier* 1821 [holotype L! (photo seen L 0052206), isotype L! (photo seen L 0052207)].
- Tectaria terminalis* (Rosenst.) C. Chr., Index Filic., Suppl. Tert.: 185. 1934. Type: as for *A. terminale*.
- Aspidium falcipinnum* Alderw., Bull. Jard. Bot. Buitenzorg, sér. 2, 28: 7. 1918. Type: Sumatra, *Brooks* 374 [holotype BO, isotype BM! (BM001048599)].
- Tectaria falcipinna* (Alderw.) C. Chr., Index Filic., Suppl. Tert.: 179. 1934. Type: as for *A. falcipinnum*.

*Rhizome* short, erect or ascending, densely scaly; scales basifixed, bicolored, dark brown centrally with narrowly paler margin, 5–10 × 1–2 mm, linear-lanceolate, apex acuminate, margin subentire. Fronds monomorphic, simple, tri-lobed when young and becoming unipinnate when mature; stipes castaneous to dark brown or sometimes nearly black, glossy, grooved adaxially, 13.5–66.0 cm long, covered with short hairs throughout, scaly at base; lamina ovate, 33.0–46.0 × 19.0–32.0 cm; basal pinnae 8.5–20.0 × 3.5–12.0 cm, stalked, stalk 0.4–3.5 cm long, opposite or subopposite, ovate-elliptic, apex acuminate, base asymmetrically cuneate, margin entire, more or less having basispic lobe; basal basispic lobes 1.5–8.5 × 1.5–5.0 cm, ovate-elliptic, apex acuminate, margin entire; lateral pinnae 1–2 pairs, stalked at lower pinnae and sessile upwards, stalks 0.3–1.0 cm long, 10.0–20.0 × 2.5–7.0 cm, opposite or subopposite, ovate or elliptic-oblong, slightly falcate, apex acuminate, base acute, margin entire or slightly crenate, interval 8.0–14.0 cm; terminal pinna 11.0–25.0 × 7.5–16.0 cm, ovate, apex acuminate, base acute to cuneate, margin trilobed, central lobe 6.5–14.0 × 3.5–8.5 cm, ovate-elliptic, apex acuminate, margin entire or subcrenate, lateral lobes 3.5–8.0 × 1.0–4.0, ovate-lanceolate, apex acuminate, margin entire, proliferous bulbils on rachis or petiole sometimes present; chartaceous, glabrous on both surfaces except few short hairs on sinus, midrib and main veins, venation anastomosing forming many irregular areoles with free included veinlets, veinlets free, forked, costal areoles having many simple included veinlets. Sori round, terminal on free included veinlets, scattered throughout abaxially, usually more than one in each areole; indusia round-reniform, thin, brown, dorsifixed, caducous. **Fig. 4.2.**

Thailand.— PENINSULAR: Krabi (Khao Pra-Bang Khram Wildlife Sanctuary), Phangnga (Khao Ta Pae, Klong Hin Poeng, Sra Nang Manora Forest

Park), Phuket (Khao Nakkerd), Satun (Khuan Kalong), Songkhla (Namtok Boriphath Forest Park), Trang (Huai Yot, Palian), Yala (Betong, Than To), Narathiwat.

Distribution.— MALESIA [Peninsular Malaysia, Singapore, Sumatra, Java (type), Lombok, Borneo, Sulawesi, Philippines (Luzon, Mindoro, Palawan, Samar, Mindanao, Sulu Archipelago), Moluccas, New Guinea]; Papua New Guinea, Bismarck Archipelago (New Britain, New Ireland), Solomon Islands.

Ecology.— Terrestrial in moist semi-shade along stream on limestone or sandstone bedrock in evergreen forest at near sea level to 500 m alt.

Vernacular.— Fern mae look on (เฟิร์นแม่ลูกอ่อน).

Uses.— Ornamental plants.

Note.— According to Flora of Thailand Vol. 3 Part 3 (Tagawa and Iwatsuki, 1988), the distribution in Lampang province was recorded. On the contrary, I have not seen that specimen yet. The specimen has not been seen for this study.

Specimens examined.— **THAILAND:** Yala, Betong, c 500 m, 11 Mar. 1925, *A.F.G. Kerr* 10080 (BK, BM, K); Yala, Than To, Ban Chulaphon Phattana 7 area, 125 m, 9 Feb. 2004, *D.J. Middleton, M. Phuphat, R. Pooma & K. Williams* 2839 (BKF); Phangnga, Mueang Phangnga, Sra Nang Manora Forest Park, 8° 30' 42" N, 98° 32' 35" E, 50 m, 16 Sep. 2010, *D.J. Middleton, K. Bunpha, P. Karaket, S. Lindsay, T. Phutthai, S. Suddee & N. Tetsana* 5444 (BKF, PSU, QBG); Yala, Bannang Sata, 70 m, 28 Jul. 1923, *E. Smith* 1845 (K); Satun, near sea level, 21 Jan. 1924, *E. Smith* 2697 (K); Krabi, Khlong Thom, Khlong Thom Nuea, Khao Phra-Bang Khram Wildlife Sanctuary, 75 m, 17 Jan. 2006, *J.F. Maxwell* 06-63 (CMUB); Songkhla, Rattaphum, Namtok Boriphath Forest Park, 75 m, 20 Dec. 1984, *J.F. Maxwell* 84-540 (BKF, P, PSU); Satun, Khuan Kalong, Thung Nui, near Nam Rah Village, 250 m, 7 Jan. 1985, *J.F. Maxwell* 85-55 (BKF); Phuket, Khao Nakkerd, 318 m, 5 May 1988, *K. Lukchant* 10 (BCU); Trang, Palian, Chao Pa Waterfall area, 7° 14' 15.9"N 99° 50' 41.6"E, c 80 m, 22 Mar. 2012, *P. Wilkie, J.S. Wai, M. Stankovic, D. Davicovic* PW924 (E); Phangnga, Klong Hin Poeng, 500 m, 27 Mar. 2000, *P. Suksathan* 2492 (QBG); from Narathiwat, collected at Suan Luang Rama IX, 1 Mar. 2000, *P. Suksathan* 2959 (QBG); Trang, Huai Yot, Huai Hin Tan, 19 Feb. 1961, *P. Suvarnakoses* 1628 (BKF); Songkhla, Rattaphum, Namtok Boriphath Forest Park, 30 m, 14 Sep. 1977, Narathiwat, Her Royal Highness Princess Siridhorn Project, *T. Boonkerd & R. Pollawatn* 288 (BCU); Phangnga, Mueang Phangnga, Khao Ta Pae, Tham Num Phud, 17 May 2012, *T. Boonkerd et al.* 2011-565 (BCU);

**MALESIA:** **Singapore**, *R.W. Hullett* s.n. (BM); **Sumatra**, *Brooks* 374 (BM), *C.J. Brooks* s.n. (BM), *H.H. Bartlett* 6414 (L), *J.A. Lörzing* 12401 (K), *J.A. Lörzing* 5542, 5710 (L), *Korthals* 453 (L), *Korthals* s.n. (L, P), *Lobb* 2432 (L), *R.S. Toroes* 825 (P); **Java**, *B. v/d Brink* 5097 (L), *Blume* s.n. (BM (photo), L, P (photo)), *Zollinger* 2432 (B, BM, L, P); **Borneo**, *A.C. Jermy* 13569, 14243 (BM), *A.C. Jermy & J.M. Rankin* 14851 (BM), *A.C. Jermy* 13107:4, 13569 (BM), *A. Kostermans* 13132 (L, P), *C. Hose* 44/211 (BM), *C.J. Brooks* PRO 13 (BM), *Dr. E. Mjober* s.n. (BM), *James Mamit* S. 35219 (L), *J.P. van Niel* 4579 (L), *J.S. Burley, Tukirin et al.* 2739 (L), *K. Iwatsuki, M. Kato, G. Murata & Y.P. Moge* B-518, B-712, B-743, B-870, B-873, B-976, B-2206 (L), *L.L. Forman* 919 (L), *M.A. Cook* 10 (L), *M. Hotta* 13187, 13711 (L), *M. Kato & H. Wiriadinata* B-5014, B-6232 (L), *M. Kato* SA-86 (L), *M. Kato, M. Okamoto, K. Ueda, D. Darnaedi & E.B. Walujo* B-8352 (L), *P.S. Ashton* A. 110 (K), *R.J. Johns* 6695 (K, L), *R.J. Johns* 6819 (L), *R.J. Johns* 7063 (K), *W. Meijer* 2286a

(L); **Sulawesi**, Coode 6000 (K); **Philippines: Luzon**, A.D.E. Elmer 8329 (K, L, P), A.D.E. Elmer 18135 (K, P), C.G. Matthew s.n. (K), E.B. Copeland 2024 (B), G.E. Edaño PNH 35871 (K), L.A. Loher s.n. (P), M. Ramos 2160 (B, K, P), M.G. Price 1325, 1443 (K); **Mindoro**, M.D. Sulit & H.C. Conklin PNH 16673 (K), Merrill 5874 (P), M.G. Price 696 (K, L), M. Ramos 39741 (P); **Palawan**, E.D. Merrill 9624 (L, P); **Samar**, M.G. Price & B.F. Hesnaez 430 (K); **Mindanao**, E.B. Copeland 1466 (P), E.B. Copeland 1776 (B), M. Ramos, G. Edaño 36569 (P); **Sulu Archipelago**, A. G. Piggott 2275, 2276 (K), Sandermann Olsen 777 (K), Y. Kondo & G. Edaño PNH 38691 (K); **Moluccas**, G.W. Barclay s.n. (BM); **New Guinea**, Bamler 43 (BM), Bamler 167 (B, P), C. Koster BW 13553 (K), C. Keysser 58 (BM), D.R. Pleyte 606 (K, L), L.G. Bamler 167 (BM, P), L.J. Brass 8836 (BM), P. Puwalda 5081 (K, L), Treub 232 (K); **PAPUA NEW GUINEA**: C. King s.n. (P), Dr. R. Schlechter s.n. (B), N.A. Wakefield s.n. (BM), R. Schlechter 16187 (P); **BISMARCK ARCHIPELAGO**: **New Ireland**, A.C. Jermy 7805 (K), J.R. Croft LAE 65571 (K (photo)), J.R. Croft LAE 68321 (BM, K), **New Britain**, D.B. Foreman LAE 52117 (K); **SOLOMON ISLANDS**: A.F. Braithwaite 4021, 4879 (K), A.F. Braithwaite 4228 (K, P), H.B. Guppy s.n. (BM), J. Werloh s.n. (K), L.J. Brass 2606 (P), P.I. Forster & D.J. Liddle PIF8769 (K), R. Teona 6275 (K); **Not localized**: L.G. Bamler 167 (P).

**3. *Tectaria aurita*** (Sw.) S. Chandra, *Kalikasan* 12: 157. 1983; Holttum, *Fl. Males.*, Ser. 2, Pterid. 2: 49, f. 12e. 1991; Wardani & Jaenudin, *ASEAN Rev. Biodivers. Environm. Conservation*: 182. 2013. Type: Java, *Thunberg* s.n. [holotype S! (photo seen S-P-4817)].

*Acrostichum auritum* Sw., *J. Bot. (Schrader)* 1800(2): 12. 1801; *Syn. Fil.*: 13, 198. 1806; Hook., *Sp. Fil.* 5: 257. 1864; *Racib.*, *Pteridop. Buitenzorg*: 52. 1898. Type: as for above.

*Polybotrya aurita* (Sw.) Blume, *Fl. Javae Filic.* 15: t. 1. 1828. Type: as for *A. auritum*.

*Stenosemia aurita* (Sw.) C. Presl, *Tent. Pterid.*: 237, t. X, f. 24. 1836; Fée, *Mém. Foug.* 5. *Gen. Filic.* 55: t. IIIA. 1852; Alderw., *Malayan Ferns*: 726. 1908; Backer & Posth., *Varenfl. Java*: 79. 1939; Copel., *Fern Fl. Philipp.*: 301. 1960; Walker, *J. Linn. Soc. Bot. Suppl.* 1: 109. 1973. Type: as for *A. auritum*.

*Polybotrya orientalis* Blume, *Enum. Pl. Javae*: 99. 1828. — Type: Noesa Kambangan, Blume s.n. [holotype L (*n.v.*)].

*Polybotrya cicutaria* Blume, *Enum. Pl. Javae*: 99. 1828; *Fl. Javae Filic.* 17: t. 2. 1828. Type: West Java, Blume s.n. [holotype L 908, 24-874 (*n.v.*)].

*Stenosemia cicutaria* (Blume) C. Presl, *Tent. Pterid.*: 237. 1836. Type: as for *P. cicutaria*.

*Stenosemia aurita* (Sw.) C. Presl var. *reducta* Alderw., *Bull. Jardin Bot. Buitenz.*, ser. 3, 5(3): 225. 1922. Type: Sumatra, Bij Lan Rakit, ten z. v. Stedan, ca. 300 m, J. A. Lörzing 6354 [holotype ?, isotype L (*n.v.*), photo B!].

*Rhizome* short, erect, bearing a tuft of fronds at apex; scales basifixed, concolorous, dark brown to castaneous, 5–8 × 1–2 mm, linear-lanceolate, apex acuminate, margin entire. *Fronde*s dimorphic, lamina bipinnatifid. *Sterile fronds*; stipes dark brown to castaneous, glossy, grooved, 25.5–32.5 cm long, covering with short brown hairs throughout, densely scaly at base; lamina ovate-subdeltoid, 20.0–22.0 × 17.0–19.0 cm; basal pinnae 9.5–11.0 × 7.0–8.0 cm, asymmetric, opposite, stalked, 0.2–0.5 cm long, ovate, apex acuminate, base round to unequally cuneate, margin

deeply lobed to 2/3 towards costa, lobes lanceolate-oblong, apex acute, margin entire, lobes on acroscopic side usually shorter than ones on basicopic side, basal basicopic lobe the longest, 4.5–5.5 × 1.5–2.5 cm, lanceolate-elliptic, apex acute, margin lobed; lateral pinnae 1 pairs, 8.0–8.5 × 2.5–3.0 cm, opposite, sessile, oblong-lanceolate, apex acuminate, base cuneate, margin deeply lobed to 1/3 towards costa, lobes lanceolate, apex acute, margin entire; terminal pinna 14.0–16.0 × 11.0–12.0 cm, ovate-subtriangular, apex acuminate, base cuneate, margin deeply lobed to 4/5 towards costa, lobes oblong-lanceolate, apex acute, margin entire to shallowly lobed; chartaceous, pubescent on both surface, densely hairy at rachis, costa and main veins, veins partly anastomosing forming costal areoles without free included veinlets, otherwise free, forked. *Fertile fronds*; stipes dark brown to castaneous, up to 55.0 cm long, covering with short brown hairs throughout, densely scaly at base; lamina much contracted, 15.0 × 9.0 cm, ovate-subdeltoid; basal pinnae 7.0–8.0 × 1.0–2.5 cm, opposite, shortly stalked, lanceolate, apex acuminate, base cuneate, margin deeply lobed to 1/2–2/3 towards costa, lobes lanceolate-falcate, basal basicopic lobe the longest; lateral pinnae 1 pairs, opposite, 3.0–4.5 × 0.3–1.0 cm, linear-lanceolate, apex acuminate, base fused with costa, margin lobed; terminal pinna 9.0 × 5.5 cm, ovate-subdeltoid, apex acuminate, base cuneate, margin deeply lobed to 4/5 towards costa, lobes linear-lanceolate, apex acute, margin subentire to shallowly lobed; chartaceous, pubescent on both surface, densely hairy at rachis, costa and main veins, veins hardly visible, pinnate. *Sori* confluent, acrostichoid abaxially, exindusiate. **Fig. 4.3.**

Thailand.— PENINSULAR: Satun (Khuan Kalong).

Distribution.— Malesia [Sumatra, Java (type), Lesser Sunda Islands (Lombok, Tanimbar Islands), Borneo, Sulawesi, Philippines (Luzon, Palawan), New Guinea]; Papua New Guinea, Bismarck Archipelago (Admiralty Islands, New Ireland), Solomon Islands, New Hebrides (Vanuatu).

Ecology.— Terrestrial in shady areas near stream on limestone bedrock in evergreen forest at 200 m.

Note.— Very similar to *Tectaria nayarii* Mazumdar in appearance but differing in its basal basicopic lobes of basal pinnae. Holttum (1991b) reported that this species has a widespread distribution in Malesian region except for the Peninsular Malaysia. It is noted here that it is the first record of this species in mainland Asia.

Specimens examined.— **THAILAND:** Satun, Khuan Kalong, Thung Nui, near Nam Rah Village, 200 m, 19 Aug. 1984, *J.F. Maxwell* 84-98 (PSU);

**MALESIA: Sumatra**, *C.B. Kloss* 14621 (K), *C.G. Matthew* s.n. (K), *H.O. Forbes* 1840β (B), *M. Jacobs* 8031 (K), *W. Hancock* 18 (K), *W.J. Lütjeharms* 4600 (K); **Java**, *C.M. Winterbottom* s.n. (K), *J.A. McDonald*, *Afriastini* 3311 (K), *J.A. Wellink* s.n. (K), *J.G. Hallier* s.n. (K), *J.P. Mousset* 21 (K), *J. van Borssum Waalkes* 394 (K), *P.J. Eyma* s.n. (K), *T. Lobb* 211 (K), *Thunberg* s.n. (S), *W.H. de Vriese* 297 (K), *W. Meijer* 2950 (K), *Zollinger* 427 (K, P); **Lesser Sunda Islands, Lombok**, *A. Ernst* 450, 484 (K); **Borneo**, *A.J.G.H. Kostermans* 5482 (K), *F.H. Endert* 3048 (K), *G. Argent*, *Ratter*, *Leopold*, *Dongop*, *Kumin* 108384 (K), *W. Meijer* SAN20533 (K), *Winkler*, *Hubert* 2687 (K); **Sulawesi**, *G.J. de Joncheere* 1718 (K), *J.E. Teysmann* 12435 (K), *O. Beccari* s.n. (K), *P. Buwalda* 3697 (K), *P.J. Eyma* 3749 (K); **Philippines, Luzon**, *M.G. Price* 477, 2036, 2040, 3005 (K); **Palawan**, *J. Dransfield* SMHI 1207 (K); **Moluccas**, *Idjan*, *Mochtar* 197 (K), *M. Kato*, *K. Ueda*, *M. Okamoto* C-5003 (K), *M. Kato*, *K. Ueda*, *U. W. Mahjar* C-2076 (K), *Nedi* 241 (K), *W.H. de*

*Vriese* 301 (K); **Ambon**, C.B. Robinson 444 (K), E. Cosson s.n. (P); **Tanimbar Islands**, P. Buwalda 4650 (K); **New Guinea**, L.S. Gibbs 6176 (K), O. Beccari s.n. (K); **PAPUA NEW GUINEA**: J.R. Croft 1682 (K), J.R. Woodhams 71 (K); **BISMARCK ARCHIPELAGO**: **Admiralty Islands**, J.R. Croft 1128, 1133 (K); **New Ireland**, G. Brown s.n. (K); **SOLOMON ISLANDS**: s.coll. s.n. (K; K000598127); **NEW HEBRIDES**: **Vanuatu**, A.F. Braithwaite RSNH2529 (K), F. Mitchell FM237 (K).

**4. *Tectaria barberi*** (Hook.) Copel., Philipp. J. Sci., C 2: 414. 1907; Holttum, Rev. Fl. Malaya ed. 1, 2: 508, f. 300. 1955 ['1954']; A. Johnson, A Student's Guide to the Ferns of Singapore Island: 84. 1977; Tagawa & K. Iwats., Fl. Thailand 3(3): 371, f. 34.2. 1988; Holttum, Kew Bull. 43(3): 483. 1988; Fl. Males., Ser. 2, Pterid. 2: 52. 1991; I.M. Turner, Gard. Bull. Singapore 47(1): 53. 1995; Boonkerd & Pollawatn, Pterid. Thailand: 211. 2000; S. Linds., D.J. Middleton, Boonkerd & Suddee, Thai For. Bull., Bot. 37: 98. 2009. Type: Borneo, *Barber* 276 [lectotype K! (K000236806); paralectotypes Myanmar, Tavoy, *Wallich* 379 K! (K001080715), *Wallich* s.n. K! (K000236017)].

*Polypodium barberi* Hook., Sp. Fil. 5: 100. 1864. Type: as for above.

*Dictyopteris barberi* (Hook.) Bedd., Ferns Brit. India: t. 322. 1866; Handb. Ferns Brit. India: 298, f. 154. 1892; Alderw., Malayan Ferns: 515. 1908. Type: as for *P. barberi*.

*Aspidium kunstleri* Bedd., Handb. Ferns Brit. Ind. Suppl.: 44. 1892; Alderw., Malayan Ferns: 236. 1908. Type: Malaysia, Perak, Gopeng, *Dr. King's Collector* 405 [lectotype (designated here) K! (K000236022), isolectotype K! (K000236021)].

*Phegopteris polycarpa* Mett. ex Kuhn, Linnaea 36: 124. 1869. Type: Singapore, *Jagor* 222 [holotype B! (B 20 0167564), line drawing B! (B 20 0167565)].

*Dictyopteris polycarpa* (Mett. ex Kuhn) Bedd., Ferns Brit. India Suppl.: 20. 1876; Handb. Ferns Brit. India: 300. 1892. Type: as for *P. polycarpa*.

*Aspidium kuhnii* C. Chr., Index Filic.: 78. 1905, not *A. polycarpum* Blume. Type: as for *P. polycarpa*.

*Rhizome* short, erect to ascending; *scales* basifixed, concolorous, dark brown, 3–10 × 1–1.5 mm, linear-lanceolate, apex acuminate, margin minutely toothed. *Fronde*s monomorphic, lamina simple, 3–5 lobed, pentagonal in immature plants, unipinnate; stipes dark stramineous to castaneous, glossy, grooved adaxially, 50.0–60.0 cm long, covered with short hairs throughout, scaly at nearly base; lamina 30.0–40.0 × 30.0–35.0 cm, elliptic-oblong in outline; basal pinnae 20.0–25.0 × 11.0–15.0 cm, alternate, stipitate, stalk 1.0–1.5 cm, elliptic in outline, apex acute to acuminate, margin deeply lobed, acroscopic lobe 1.5–3.0 × 1.0–1.5 cm, lanceolate, apex acuminate, base round, margin entire; basisopic lobe 8.0–12.0 × 1.5–2.0 cm, lanceolate, apex acuminate, margin entire to shallowly lobed; lateral pinnae 4–6 pairs, alternate, shortly stalked at lower pinnae and sessile upward, 11.0–20.0 × 2.0–3.0 cm, lanceolate, apex acuminate, base acute to subtruncate or fused to costa, margin subentire to shallowly lobed; terminal pinna 10.0–18.0 × 8.0–15.0 cm, ovate-subtriangular, apex acuminate, base cuneate, margin deeply lobed to 2/3 towards costa, lobes lanceolate, apex acute to acuminate, margin subentire; chartaceous, glabrous on both surfaces except few short hairs on midrib or main veins beneath,

veins fully anastomosing forming many areoles with free included veinlets, veinlets free, simple, costal areoles lacking free included veinlets. *Sori* round, usually terminal on free veinlets and rarely dorsal on anastomosing veins, one in each areole, irregular scattered on the lower surface of frond; indusia, round-reniform, caducous. **Fig. 4.4.**

Thailand.— PENINSULAR: Surat Thani (Bandon), Nakhon Si Thammarat (Khao Nan National Park), Phatthalung (Kong Ra, Tamot), Satun, Songkhla (Ton Nga Chang Wildlife Sanctuary).

Distribution.— Myanmar (Tavoy), Malesia [Peninsular Malaysia, Singapore, Sumatra, Borneo (type), Philippines (Sulu Archipelago)].

Ecology.— Terrestrial near streams in evergreen forest, from near sea level to 350 m alt.

Specimens examined.— **THAILAND:** Satun, near sea level, 23 Jan. 1924, *E. Smith* 2687 (K); Songkhla, Ton Nga Chang Waterfall, 350 m, 2 Sep. 2011, *M. Stankovic, K. Jamtsho & B. Hassama* 45 (PSU); Phatthalung, Tamote, Lan Mom Jui, 12 Feb. 2000, *P. Pangul* 345 (PSU); Surat Thani, Bandon, Jun. 1924, *Put for Eryl Smith* 2698 (K); Surat Thani, Bandon, near sea level, Jun. 1924, *Put for Eryl Smith* 2702 (K); Phatthalung, Kong Ra, Khlong Chaloem, Manora Waterfall, c 300 m, 19 Sep. 2007, *S. Chantanaorrapint & A. Chantanaorrapint* 40 (PSU); Nakhon Si Thammarat, Khao Nan National Park, Huai Kaeo, 24 Jan. 2007, *T. Boonkerd, S. Chantanaorrapint & W. Khwaiphon* 394 (BCU);

**MYANMAR:** *Tavoy*, *Wallich* 379 (K), *Wallich* s.n. (K); **MALESIA:** **Peninsular Malaysia**, *Abd. Samat b. Abdullah* s.n. (L), *Baker* 836 (L), *D. Lorrain* 1991 (B), *Dr. King's Collector* 405 (K); **Singapore**, *F. Kehding* 3088 (P), *Jagor* 222 (B), *J. F. Maxwell* 76-719 (L), *J. F. Maxwell* 82-71 (L), *J. Sinclais* s.n. (P), *S. Y. Tan* TSY2009-130 (L); **Sumatra**, *L. Burchard* s.n. (B, P), *L. Burchard* 1 (B, K, L, P), *de Wilde* 14585 (L), *Gardette, E.* 198 (L), *H. Surbeck* 1255, 1263 (L), *Hendrien Beukema* HB165, HB170 (L), *Korthals* s.n. (L), *P. Buwalda* 7100 (K, L), *W. J. J. O. de Wilde and B. E. E. de Wilde-Duyffes* 14585 (L); **Borneo**, *Axel D. Poulsen* 125 (K), *Barber* 276 (K), *B. S. Parris* 10760, 11276 (K), *Charles Hose* 713 (K), *Cheng-Wei Chen* Wade4193 (TAIF), *Governor Creagh* s.n. (K), *H. F. Comber* 4188 (K), *H. Low* s.n. (K), *Hose* 234, s.n. (K), *J. J. Vermeulen* 1279 (L), *K. Iwatsuki, M. Kato, G. Murata & Y. P. Mogeia* B-384, B-519, B-523, B-706, B-730 (L), *K. Iwatsuki, M. Kato, G. Murata & Y. P. Mogeia* B-871 (K, L), *Lobb* 1857 (K), *Mary Strong Clemens* 9475 (K), *M. Kato* SA-17, SA-131 (L), *M. Kato, M. Okamoto & K. Ueda* B-11618 (L), *M. Kato & H. Wiriadinata* B-6939 (K, L), *M. Hirano & M. Hotta* 376 (L), *Mitsuru Hotta* 12667, 13443, 13823 (L), *Molly* 903 (B), *Native collector* 2656 (P), *P. C. van Welzen* 904 (L), *P. J. Edwards* s.n. (K), *P. M. Synge* 537 (K), *P. S. Ashton* A. 81 (K), *R. J. Johns* 7112, 7118 (K), *R. J. Johns* 7469 (K, L), *S. Dransfield, J. Dransfield, P. C. Boyce* 1033 (K), *S. P. S. San* 81693 (K), *Veitch* 6/78, s.n. (K), *Wiriadinata* 3264 (L), *Yi-Shan Chao* Chao2387 (TAIF); **Philippines, Sulu Archipelago**, *C. A. Wenzel* 266 (P), *Elmer D. Merrill* 5875 (P), *Madulid et al.* 1426 (L), *Sandermann Olsen* 668 (K), *Y. Kondo & G. Edaño* s.n. (K).

**5. *Tectaria brachiata*** (Zoll. & Moritzi) C.V. Morton, *Contr. U.S. Natl. Herb.* 38(6): 217. 1973; C.J. Goudey, *Handb. Ferns Austral. N. Zeal.*: 170. 1989; Holttum, *Fl. Males.*, Ser. 2, Pterid. 2: 70. 1991; I.M. Turner, *Gard. Bull. Singapore* 47(1): 53. 1995; Bostock, *Fl. Australia* 48: online, f. 133C–D. 1998; Boonkerd &



Pollawatn, Pterid. Thailand: 211. 2000; S. Linds., D.J. Middleton, Boonkerd & Suddee, Thai For. Bull., Bot. 37: 98. 2009. Type: Java, *Zollinger* 655 [lectotype G! (photo seen G00358180), isolectotypes B! (B 20 0167583), G! (photo seen G00358181), L! (photo seen L 0052149), photos BM!, K! (K000236872, K000236873), paralectotypes G!, *Zollinger* 655A (photo seen G00358182, G00358183)].

*Aspidium brachiatum* Zoll. & Moritzi, Natuur- Geneesk. Arch. Ned.-Indië 1: 399. 1844. Type: as for above.

*Aspidium zollingerianum* Kunze, Bot. Zeitung (Berlin) 4: 462. 1846 (non Bedd., 1868), *nom. superfl.* Type: as for *A. brachiatum*.

*Tectaria variolosa* sensu auctt. K. Iwats [non (Wall. ex Hook.) C. Chr.], Amer. Fern J. 63(3): 131. 1973, *pro parte, quoad E. Smith* 1843; Tagawa & K. Iwats. in Smitinand & K. Larsen [non (Wall. ex Hook.) C. Chr.], Fl. Thailand 3(3): 368, *pro parte, quoad B. Hansen and T. Smitinand* 12213, *E. Smith* 593, 1843, 2696, 2706, 7693, *J. F. Maxwell* 86-1102, 86-274 & *Put* 707.

*Rhizome* short, erect to ascending, densely scaly at apex; *scales* basifixed, concolorous, dark brown, 2–4 × 1–1.5 mm, lanceolate, apex acuminate, margin hairy. *Fronde*s dimorphic, fertile fronds similar in shape but smaller than sterile fronds, lamina bipinnatifid to bipinnate at base, bipinnatifid upwards; stipes stramineous to light brown, 15.0–27.0 cm long in sterile fronds and 18.0–27.0 cm long in fertile fronds, scaly nearly base, covered with short hairs; lamina 19.0–32.0 × 12.0–25.0 cm in sterile fronds and 13.0–16.0 × 10.0–12.0 cm in fertile fronds, ovate-elliptic in outline; basal pinnae bipinnatifid when young and becoming to bipinnate when mature, 7.0–22.0 × 4.0–10.0 cm in sterile fronds and 3.0–7.0 × 1.5–4.5 cm in fertile fronds, asymmetrical, stipitate, stalks 0.5–1.5 cm long, opposite, ovate-lanceolate in outline; basal basiscopic pinnule or basal basiscopic lobe 4.5–15.0 × 1.5–3.0 cm in sterile fronds and 1.5–5.0 × 0.4–2.0 cm in fertile fronds, subsessile to shortly stalked, lanceolate, apex acute, base round, margin subentire to shallowly lobed; acroscopic pinnules 3.0–4.0 × 1.5–2.0 cm in sterile fronds and 0.5–2.0 × 0.3–1.0 cm in fertile fronds, shortly stalked, lanceolate, apex acute, base round, margin entire to slightly crenate; terminal pinnule 5.0–18.0 × 3.0–8.0 cm in sterile fronds and 2.0–7.0 × 1.0–3.0 cm in fertile fronds, pinnatifid, asymmetric, ovate-subdeltoid, apex acuminate, base cuneate, margin deeply lobed to 1/2 way towards costules, lobes lanceolate, apex acute, margin subentire; lateral pinnae 1–3 pairs, 6.0–17.0 × 2.0–3.0 cm in sterile fronds and 4.0–9.0 × 1.5–2.5 cm in fertile fronds, asymmetric, alternate or subopposite, shortly stalked, 0.1–1.0 cm long, opposite, lanceolate, apex acuminate, base cordate, margin subentire to shallowly lobed; terminal pinna 11.0–14.0 × 7.0–13.0 cm in sterile fronds and 6.0–10.0 × 3.0–7.0 cm in fertile fronds, ovate, apex acuminate, base cordate to cuneate, margin deeply lobed to 1/2 to 2/3 towards costa, lobes lanceolate, apex acute, margin entire to irregularly crenate; texture papyraceous to chartaceous, glabrous except a few hairs on sinus, midrib and main veins beneath, veins fully anastomosing to form areoles with and without free included veinlets, veinlets simple, costal areoles more or less having free included veinlets, veinlets free, simple. *Sori* round, terminal on free included veinlets in areoles, one in each areoles, arranged in two rows between main veins, usually sunken on lamina; indusia round-reniform, brown, peltate, stiff, persistent. **Fig. 4.5.**

Thailand.— PENINSULAR: Surat Thani (Ban Don, Ko Samui), Phangnga (Khao Lak-Lam Ru National Park, Ko Phra Thong), Nakhon Si Thammarat (Hat Khanom–Mu Ko Thale Tai National Park, Khao Nan National Park, Ron Phibun), Trang (Khao Chong, Ko Libong), Phatthalung (Khao Pu-Khao Ya National Park), Satun, Songkhla (Namtok Boriphath Forest Park, Ton Nga Chang Wildlife Sanctuary), Yala (Bannang Sata, Bang Lang National Park), Narathiwat (Budo-Su-ngai Padi National Park).

Distribution.— Cambodia, Malesia [Langkawi Islands, Peninsular Malaysia, Java (type), Pulau Bawean, Borneo, Sulawesi, Tanimbar Islands, New Guinea], Papua New Guinea, Australia (NE Queensland).

Ecology.— Terrestrial in shaded area near stream banks in evergreen forest at 20–480 m alt.

Vernacular.— Pak kut hin (ผักกูดหิน) (Peninsular).

Note.— This species is very close to *Tectaria impressa* (Fée) Holttum but differing in its venation and lateral pinnae. The lateral pinnae of sterile fronds of *T. brachiata* are much less deeply lobed than those of *T. impressa* and there are many free and branched veinlets both in costal and some other areoles (Holttum, 1985). Based on Thai specimens, I totally agree with Holttum's study. In addition, I notice that spores have the thicker perispore than perispore of *T. impressa*.

Specimens examined.— **THAILAND:** Trang, Ko Libong, 10 Feb. 1966, *B. Hansen and T. Smitinand* 12213 (BKF, K); Phangnga, Khura Buri, Ko Phra Thong, Khao Pha Sang, 50 m, 6 Apr. 2003, *C. Phengkklai et al.* 13803 (BKF); Nakhon Si Thammarat, Khanom, Mu Ko Thale Tai National Park, Nam Tei Waterfall, 9° 5' N 99° 54' E, 150 m, 18 Feb. 2004, *D.J. Middleton, M. Phuphat, R. Pooma & K. Williams* 3208 (BKF); Phangnga, Takua Pa, Khao Lak National Park, Trail from headquarters just above the coastal rocks, 8° 38' N 98° 14' E 20 m, 12 Apr. 2003, *D.J. Middleton, S. Lindsay & R. Pooma* 2162 (BKF); Nakhon Si Thammarat, Ron Phibun, Khao Rum, 450 m, Feb. 1922, *E. Smith* 593 (K); Yala, Banang Sata, 60 m, 22 Jul. 1923, *E. Smith* 1843 (K); Satun, near sea level, 17 Jan. 1924, *E. Smith* 2696 (K); Surat Thani, Bandon, near sea level, Jun. 1924, *E. Smith* 2706 (K); Satun, near sea level, 14 Jan. 1924, *E. Smith* 7693 (K); Narathiwat, Bacho, Budo-Su-Ngai Padi National Park, 125 m, 18 Dec. 1986, *J.F. Maxwell* 86-1102 (BKF, CMU); Songkhla, Rattaphum, Namtok Boriphath Forest Park, 50 m, 2 May 1986, *J.F. Maxwell* 86-274 (BKF, CMU); Trang, Khao Chong Waterfalls, *Kittima* 49 (KKU); *ibid.*, *Kittima* 50 (KKU); Songkhla, Sadao, Ban Chai Kuan, 31 Mar. 1989, *Kittima* 52 (KKU); *ibid.*, *Kittima* 55 (KKU); Yala, Bang Lang National Park, La-ong Rung Waterfalls, 22 Apr. 2005, *Pooma, Chamchumroon, Phattarahirankanok, Sirimongkol, Poopath, Matchit* 5141 (BKF); Songkhla, Ton Nga Chang Wildlife Sanctuary, 28 Jan. 1992, *P. Puudjaa* 46 (BKF); Surat Thani, Ko Samui, 26 May 1927, *Put* 707 (K); Nakhon Si Thammarat, Khao Nan National Park, Huai Lhek, 9 Apr. 2005, *T. Boonkerd, S. Chantanaorrapint & W. Khwaiphan* 121 (BCU); Nakhon Si Thammarat, Khao Nan National Park, Tham Hong, 10 Jun. 2006, *T. Boonkerd, S. Chantanaorrapint & W. Khwaiphan* 207 (BCU);

**CAMBODIA:** *A. Chevalier* 31790 (BM); **MALESIA: Peninsular Malaysia,** *Birch* s.n. (BM), *J. Sinclair & K. Bin* SF 40837 (BM), *v. Balgooy* 2213 (L), *W.R. Litke* WL 256 (L); **Java,** *Zollinger* 655 (B, G, K (photo), L), *Zollinger* 655A (G); **Sulawesi,** *S. Prawiroatmodjo & S. Soewoko* 2003 (L); **Tanimbar Island,** *P. Buwalda* 4262 (K); **PAPUA NEW GUINEA:** *L.J. Brass* 7487 (BM).

6. *Tectaria chattagramica* (C.B. Clarke) Ching, *Sinensia* 2(2): 35. 1931; Dickason, *Ohio J. Sci.* 46(3): 121. 1946; Holttum, *Kew Bull.* 43(3): 481. 1988; Subh. Chandra, Fraser-Jenk., Alka Kumari & Archana Sriastava, *Taiwania* 53(2). 197. 2008; Fraser-Jenk., *Bull. Natl. Mus. Nat. Sci., Ser. B* 38(4). 176. 2012. Type: Bangladesh, Chittagong, C.B. Clarke 19879 A [lectotype K! (K001080708), paralectotypes K! C.B. Clarke 10177 (K001080707); C.B. Clarke 19767 (K001080709); C.B. Clarke 19879 M (K001080711)].

*Polypodium chattagramicum* C.B. Clarke, *Trans. Linn. Soc. London* 1(8): 548, t. 81. 1880. Type: as for above.

*Dictyopteris chattagramica* (C.B. Clarke) Bedd., *Handb. Ferns Brit. India*: 299, f. 155. 1883. — Type: as for *P. chattagramicum*.

*Rhizome* short, erect, densely scaly at apex; scales basifixed, concolorous, dark brown to castaneous, 2–5 × 0.5–1 mm, linear-lanceolate, apex acuminate, margin entire. Fronds dimorphic, lamina bipinnatifid, lateral pinnae usually absent. *Sterile fronds*, stipes dark brown to castaneous, dull, grooved, 14.0–30.0 cm long in sterile fronds and up to 50.0 cm long in fertile fronds, covered with short hairs throughout, scaly nearly base; lamina ovate-subdeltoid, 13.0–25.0 × 14.0–18.0 cm in sterile fronds and 21.0 × 16.0 cm in fertile fronds; basal pinnae 9.0–11.5 × 6.0–10.0 cm in sterile fronds and 8.5 × 7.0 cm in fertile fronds, stipitate, stalk 0.3–0.5 cm long, ovate-lanceolate, apex acuminate, base cordate, margin deeply lobed to 2/3 towards costa, lobes lanceolate-falcate, apex acute, margin entire, usually with long basal basisopic lobes, 5.0–9.0 × 2.0–3.0 cm in sterile fronds and 5.5 × 2.0 cm in fertile fronds, lanceolate, apex acuminate, margin crenate to lobed; terminal pinna 10.0–18.0 × 13.0–16.0 cm in sterile fronds and 11.0 × 8.5 cm in fertile fronds, ovate-subtriangular, apex acuminate, base cordate to cuneate, margin deeply lobed to 4/5 towards costa, lobe lanceolate, apex acuminate, margin subentire to lobed; chartaceous, glabrous on both surface except few short hairs on margin, midrib and main veins, veins in sterile fronds fully anastomosing forming areoles with free included veinlets, veinlets usually simple, veinlets in costal areoles usually absent; veins in fertile fronds fully anastomosing forming costal areoles without free included veinlets, otherwise free, forked. *Sori* round, terminal on short acroscopic branches of veinlets and dorsal on connected veins; indusia round-reniform, dorsifixed, caducous. **Fig. 4.6.**

Thailand.— NORTHERN: Phitsanulok (Huey Ya); SOUTH-WESTERN: Kanchanaburi (Thung Kang Yang Hills).

Distribution.— Bangladesh [Chittagong (type)], India (Assam), Myanmar.

Ecology.— Terrestrial near waterfall on lateritic soil, common in evergreen or deciduous forest at 100–700 m alt.

Note.— Similar to *Tectaria impressa* (Fée) Holttum but differing in its fronds and sori. Sori are located both on terminal veins and connected veins which are not in areoles as is found in sori of *T. impressa* and lateral pinnae are usually absent.

In addition, the distribution at Huey Ya has been still doubtful because it had only one mark on specimen label of *T. chattagramica* (B. Hansen, G. Seidenfaden and T. Smitinand 11254; K). It may probably be located in Phitsanulok province.

Specimens examined.— **THAILAND:** Phitsanulok, Huey Ya, 700 m, 24 Feb. 1964, B. Hansen, G. Seidenfaden and T. Smitinand 11254 (K); Kanchanaburi, Thung Kang Yang Hills, 550 m, 6 Jul. 1963, K. Larsen 10547 (K);

**BANGLADESH: Chittagong, C.B. Clarke** 10177, 19767, 19786, 19871, 19879 A, 19879 F, 19879 M (K), *C.B. Clarke* 19879 J (BM).

- 7. *Tectaria coadunata*** (Wall. ex Hook. & Grev.) C. Chr., Contr. U.S. Natl. Herb. 26: 331. 1931; Ching, *Sinensia* 2(2): 18, pl. 1, 2. 1931, *pro parte*; Dickason, Ohio J. Sci. 46(3): 121. 1946; Hara, Fl. East. Himal. 1: 481. 1966; *ibid.* 2: 213. 1971; Tagawa & K. Iwats., S. E. Asian Stud. 3(3): 86. 1965; *ibid.* 5: 97. 1967; Sledge, Kew Bull. 27: 418. 1972, *pro parte*; Nayar & Kaur, Comp. Bedd., Handb.: 52. 1974; Ohashi, Fl. East Himal. 3: 191. 1975; Holttum, Gard. Bull. Singapore 34: 137. 1981; Sledge, Bot. J. Linn. Soc. 84: 18. 1982; C.M. Kuo, Taiwania 30: 29. 1985; Holttum, Kew Bull. 43(3): 487. 1988; Tagawa & K. Iwats., Fl. Thailand 3(3): 367. 1988; Fras.-Jenk., Pakistan Syst. 5: 96. 1991; Holttum, Fl. Males., Ser. 2, Pterid. 2: 58. 1991; Manickam & Irudayaraj, Pterid. Fl. West Ghats: 260. 1992; Nayar & Geevarghese, Fern Fl. Malabar: 219. 1993; Vasudeva & Bir, Indian Fern J. 10: 123. 1993; J.L. Tsai & W.C. Shieh, Fl. Taiwan, ed. 2: 296. 1994; Irudayaraj & Bir, Indian Fern J. 14: 114. 1997; Rajagopal & Bhat, Indian Fern J. 15: 21. 1998; Chandra, Taiwania 45(1): 57. 2000; S.K. Wu, Acta Phytotax. Sin. 40(6): 530. 2002; S.G. Lu & T.Y.A. Yang, Taiwania 50(2): 158. 2005; I.M. Bhagat & S. Shrestha, Our Nature 8(1): 362. 2010; F.W. Xing, Y.H. Yan, S.Y. Dong, F.G. Wang, Christenh. & Hovenkamp, Fl. China 2–3: 735. 2013. Type: Nepal, *Wallich* 377 [holotype K! (K001080703), isotypes B! (B 20 0167850), BR! (BR0000013306205, BR0000013306212, BR0000013306229), K! (K001080704, K001080705, K001080706), UC! (UC267882)].
- Aspidium coadunatum* Wall. ex Hook. & Grev., Icon. Filic. 2: t. 202. 1831, *non* Kaulf. 1824. Type: as for above.
- Sagenia coadunata* J. Sm. in Hook., J. Bot. 4: 184. 1841. Type: as for *A. coadunatum*.
- Sagenia macrodonta* Fée, Mém. Foug., 5. Gen. Filic.: 313, t. 24 A, f. 1. 1852, *nom. superfl.* Type: as for *A. coadunatum*.
- Aspidium macrodontum* (Fée) Ching, Bull. Fan Mem. Inst. Biol. Bot. 10: 237. 1941. Type: as for *A. coadunatum*.
- Tectaria macrodonta* (Fée) C. Chr., Index Fil. Suppl. 3: 181. 1934; Tardieu & C. Chr., Fl. Indo-Chine 7(2): 410. 1941; Holttum, Rev. Fl. Malaya ed. 1, 2: 505. 1955 [‘1954’]; Dixit, Census: 143. 1984; Vasudeva & Bir, Indian Fern J. 10: 123. 1993. Type: as for *A. coadunatum*.
- Tectaria christii* Copel., Philipp. J. Sci., C 2: 416. 1907; Tagawa & K. Iwats., Fl. Thailand 3(4): 621. 1989; Holttum, Kew Bull. 43(3): 488. 1988; Fl. Males., Ser. 2, Pterid. 2: 56. 1991; Boonkerd & Pollawatn, Pterid. Thailand: 211. 2000; S. Linds., D.J. Middleton, Boonkerd & Suddee, Thai For. Bull. (Bot.) 37: 97. 2009. Type: Philippines, Luzon, Bontoc, Sagada, *Copeland* 1899 [lectotype MICH! (photo seen MICH1191039), photo K! (K000360266)].
- Aspidium pinfaense* Christ, Bull. Acad. Int. Géogr. Bot. 20: 169. 1909. — Type: China, Guizhou, *Cavalerie* 872 [holotype P! (photo seen P00644783), isotypes E! (photo seen E00748599), K! (K001080741, K001080742, K001080743, K001080744, K001080745)].
- Aspidium kwanonense* Hayata, Icon. Pl. Formosan. 8: 137–138, f. 61, f. 62. 1919. — Type: China, Taiwan, *S. Fujii* s.n. (syntype TI, photo B!).

- Tectaria kwangtungensis* Ching, Bull. Fan Mem. Inst. Biol. 2(10): 199–200, pl. 14. 1931. Type: China, Guangdong, Lienzhou, C.G. *Matthew* 39 [holotype MICH! (photo seen MICH1191450), isotypes K! (K001080731, K001080732, K001080733, K001080734, K001080735)].
- Pleocnemia kwangtungensis* (Ching) Ching, Bull. Fan Mem. Inst. Biol., Bot. 10(5): 238. 1941. — Type: as for *T. kwangtungensis*.
- Tectaria consimilis* Ching & Chu H. Wang, Acta Phytotax. Sin. 19(1): 126. 1981. Type: China, Yunnan, Xichou, K.M. *Feng* 11852 [holotype PE! (photo seen PE00050308), photo K!].
- Tectaria junlianensis* Ching & Chu H. Wang, Acta Phytotax. Sin. 19(1): 125–126. 1981. Type: China, Sichuan, Junlianin scopulis in valle, H.S. *Kung* 5237 [holotype PE (*n.v.*), photo K!].
- Tectaria coadunata* (J. Sm.) C. Chr. var. *hirsuta* Holttum, Kew Bull. 43: 488. 1988. Type: India, Darjeeling, J.S. *Gamble* 8335 [holotype K (*n.v.*)].
- Tectaria coadunata* (J. Sm.) C. Chr. var. *minor* Holttum, Blumea 35: 548. 1991; Fl. Males., Ser. 2, Pterid. 2: 59. 1991; I.M. Turner, Gard. Bull. Singapore 47(1): 54. 1995. — Type: Malaysia, Pulau Langkawi, *Henderson* SF 21383 [holotype K! (K000236455), isotype SING!].
- Aspidium cicutarium* sensu auctt. Hook. [non (L.) Sw., 1801], Sp. Fil. 4: 61. 1862, *pro parte*; Bedd., Handb. Ferns Brit. India: 220. 1892, *pro parte*.
- Nephrodium cicutarium* sensu auctt. Baker, Syn. Fil.: 299, 1867, *pro parte*; C.B. Clarke [non (L.) Baker, 1867], Trans. Linn. Soc. London II, Bot. I: 539. 1880, excl. var. *coadunatum*.

*Rhizome* short, erect, ascending to creeping, densely scaly at apex; scales basifixed, bicolored, dark brown at central portion with narrow paler margin, 3–6 × 2–3 mm, ovate, apex acuminate, margin minutely toothed. *Fronde*s monomorphic, bipinnatifid to bipinnate at base, bipinnatifid upwards; stipes stramineous to brown, dull, grooved, 13.0–30.0 cm long, covered with short hairs throughout, scaly at nearly base; lamina ovate-subdeltoid, 28.0–50.0 × 17.0–40.0 cm, basal pinnae 9.0–30.0 × 6.0–20.0 cm, opposite or subopposite, stalked, stalk 0.3–1.5 cm long, ovate-subdeltoid, apex acuminate, base cordate to cuneate margin deeply lobed, basal pinnules or basal basisopic lobes usually the longest; basal pinnule or basal basisopic lobe 3.5–16.0 × 1.5–6.0 cm, lanceolate, apex acuminate, base asymmetrically cuneate, margin deeply lobed to 1/2 towards costa, lobes lanceolate-oblong, apex obtuse, margin entire; apical pinnule 3.0–8.0 × 1.5–3.5 cm, lanceolate, apex acute, base cuneate or fused to costa, margin crenate to shallowly lobed; terminal pinnule 11.0–26.0 × 8.5–12.0 cm, ovate-subtriangular, asymmetric, apex acuminate, base asymmetrically cuneate, margin deeply lobed to 4/5 towards costule, lobes lanceolate, apex acute to acuminate, margin crenate to shallowly lobed, basal basisopic lobe of terminal pinnule usually the longest; lateral pinnae 1–2 pairs, opposite, sessile, 9.0–24.0 × 3.0–6.0 cm, lanceolate, apex acuminate, base truncate, margin deeply lobed to 1/2 towards costa, lobes lanceolate, apex acute, margin entire; terminal pinna pinnatifid, 15.0–30.0 × 12.0–26.0 cm, ovate-lanceolate, apex acuminate, base cuneate, sometimes acute, margin deeply lobed to 2/3 towards costa, lobe lanceolate, apex acute, margin entire; chartaceous, pubescent on both surface, densely hairy on midrib and main veins, veins anastomosing forming areoles with or without free included veinlets, veinlets free, simple, free veinlets in costal areoles

absent. *Sori* round, terminal on included free veinlets, one in each areoles, arranged in two rows between main veins; indusia round-reniform, thin, dorsifixed, persistent. **Fig. 4.7.**

Thailand.— NORTHERN: Mae Hong Son (Khun Yuam, Mae Sariang), Chiang Mai (Chiang Dao Wildlife Sanctuary, Doi Inthanon National Park, Doi Pa Kao, Doi Suthep-Pui National Park, Mae Cham), Lamphun (Doi Khun Tan National Park).

Distribution.— India (Himachal Pradesh, Uttarakhand, Sikkim, Assam, Calcutta), Nepal (type), Bhutan, Bangladesh (Chittagong), Sri Lanka, China (Tibet, Sichuan, Yunnan, Guizhou, Guangxi, Guangdong, Taiwan), Myanmar, Laos, Vietnam, Malesia [Sumatra, Philippines (Luzon)].

Ecology.— Terrestrial on mountain slopes or growing in rock crevices of limestone or granitic bedrocks in shaded areas in hill evergreen forest or deciduous forest at 350–1,800 m alt.

Note.— Similar to *Tectaria remotipinna* Ching & Chu H. Wang but differing in the absence of rosette scales at rhizome apex and stipe base.

Specimens examined.— **THAILAND:** Mae Hong Son, c 28 km S of Khun Yuam, c 450 m, 29 Dec. 1965, *E. Hennipman* 3505 (BKF, BM, K, L); Chiang Mai, Chiang Dao Wildlife Sanctuary, Oct.-Nov. 1922, *E. Smith* 1104 (K); Chiang Mai, Chiang Dao Wildlife Sanctuary, 1,200 m, Oct.-Nov. 1922, *E. Smith* 1106 (K); Chiang Mai, Chiang Dao Wildlife Sanctuary, 600–1,300 m, 25 Sep. 1971, *G. Murata, K. Iwatsuki & C. Pengklai* T-14968 (BKF, L, P); Chiang Mai, Doi Inthanon National Park, Doi Ang Ka, 1,470 m, 11 May 1928, *H. B. G. Garrett* 513 (BCU, K); Chiang Mai, Doi Pa Kao, 1,630 m, 27 Aug. 1931, *H. B. G. Garrett* 708 (BCU, BKF, K); Chiang Mai, Doi Suthep-Pui National Park, 1,450 m, 23 Aug. 2002, *J. F. Maxwell* 02-280 (BKF, L); Chiang Mai, Mueang Chiang Mai, Doi Suthep-Pui National Park, 1,025 m, 26 Jul. 1989, *J. F. Maxwell* 89-942 (CMU, L); Lamphun, Mae Tha, Doi Khun Tan National Park, Doi Tan Ku, 550–600 m, 30 Aug. 1994, *J. F. Maxwell* 94-951 (BKF, CMUB, L); Chiang Mai, Mae Cham, Ban Chan, Huay Bong Village, 1,050 m, 17 Jul. 1999, *J. F. Maxwell* 99-62 (BKF, CMUB); Mae Hong Son, S of Mae Sariang, 350 m, 8 Jul. 1968, *K. Larsen, T. Santisuk & E. Warncke* 2242 (L, P); Chiang Mai, Doi Suthep-Pui National Park, c 900 m, 21 Mar. 1965, *M. Tagawa & I. Yamada* T-58 (BKF); Chiang Mai, Chiang Dao Wildlife Sanctuary, 1,400–1,800 m, 1 May 1966, *M. Tagawa & K. Iwatsuki* T-4398 (L); Chiang Mai, Chiang Dao Wildlife Sanctuary, 1,100–1,800 m, 13 Sep. 1967, *M. Tagawa, T. Shimizu, H. Koyama, M. Hutoh & A. Nalampoorn* T-9993 (BKF, E, K); Chiang Mai, Chiang Dao Wildlife Sanctuary, 23 Dec. 2013, *R. Pollawatn* 1588 (BCU); Chiang Mai, Doi Suthep-Pui National Park, beside road to Bhubing Rajanives Palace, 2 Oct. 2014, *R. Pollawatn* 2159 (BCU); Chiang Mai, Chom Thong, Doi Inthanon National Park, Mae Pan Waterfalls, 1,100 m, 16 Oct. 1979, *T. Shimizu, H. Toyokuni, H. Koyama, T. Yahara & T. Santisuk* T-18944 (BKF, L); Chiang Mai, Chiang Dao Wildlife Sanctuary, 1,500 m, 15 Sep. 1967, *T. Shimizu & M. Hutoh* T-10200 (BKF, L);

**INDIA:** *Bates* s.n. (K), *C. B. Clarke* 18917E (BM), *C. B. Clarke* 21473A (K), *Falconer* 839 (B), *I. Warburgianum* 1073 (B), *J. Thomson* s.n. (B, K), *Lau* s.n. (K); **Himachal Pradesh,** *T. Bliss* 251, 301 (K); **Uttarakhand,** *J. S. Gamble* 22357 (K), *R. R. Stewart* 21377 (K), *R. Strachey and J. E. Winterbottom* 17 (BM, K); **Sikkim,** *J. D. H.* 226 (B); **Assam,** *C. J. Simons* s.n. (BM), *C. W. Hope* s.n. (BM), *Griffith* s.n. (B), *I.*

*G. Mann* s.n. (B), *J. D. H. & J. J.* s.n. (B); **Calcutta**, *C. Morris* s.n. (B); **NEPAL**: *C. E. B. Bonnez* 2101 (BM), *Enep* 59 (E), *H. Hara, H. Kanai, S. Kurosawa, G. Murata, M. Togashi & T. Tuyama* 763 (E), *H. Ikeda, T. Kawahara, O. Yano, N. Yamamoto, M. F. Watson, Z. H. Li, M. N. Subedi & S. K. Acharya* 20818043 (E), *H. Ohba, M. Wakabayashi, M. Suzuki & S. Akiyama* 8331391 (BM), *H. Ohba, M. Wakabayashi, M. Suzuki & S. Akiyama* 8331569 (BM), *J. D. A. Stainton* 3727, 3832 (BM), *J. D. H.* 19 (K), *O. Polunin, W. R. Sykes & L. H. J. Williams* 5748 (BM), *M. Mikage, T. Kajita, F. Kiuchi, N. Kondo, P. Lacoul, M. Suzuki & K. Yonekura* 9558322 (E), *R. L. Fleming* 2032A (K), *R. L. Fleming* 2032B (K), *Wallich* 226 (B), *Wallich* 377 (B, K); **BHUTAN**: *F. Ludlow & G. Sherriff* 577 (BM), *H. Kanai, G. Murata, H. Ohashi, O. Tanaka & T. Yamazaki* 13960 (BM); **BANGLADESH**: **Chittagong**, *C.B. Clarke* 26960B (BM); **SRI LANKA**: *Thwaites* C.P. 1356 (B, E), *W.A. Sledge* 934 (E); **CHINA**: *E. Faber* s.n. (B), **Tibet**, *F. Kingdr Ward* s.n. (K), *George Forrest* 26770 (BM); **Sichuan**, *E.H. Wilson* 5376 (K), *Scallau* s.n. (B); **Yunnan**, *A.G. Piggott* 1074 (BM), *George Forrest* 17047 (K), *J. Cavalerie* 1451, 7031, 7036, 7642 (K), *M. Kato, Y. Shimizu, N. Murakami, S. Akiyama and X. Cheng* 477 (BM); **Guizhou**, *Cavalerie* 872 (K), *L. Martin & R.P. Bodinier* 2529 (E, K); **Guangdong**, *C. G. Matthew* 39 (K); **Taiwan**, *B.J. Wang* 9601, 10104, 10105 15566 (TAIF), *C.C. Liu* 569 (TAI), *C.S. Kuoh* 4082 (TAI), *C.K. Liou* 1617 (TAIF), *C.M. Kuo* 739, 874, 923, 1964, 10493, 14595, 15298 (TAI), *C.S. Feung & M.T. Kao* 249 (TAI), *C.S. Kuoh* 3989, 4082 (TAI), *E. Matsuda* s.n. (TAI), *F.H. Fan* s.n. (TAIF), *H.L. Chiang* 1411 (TAIF), *H.N. Yang* 1995 (TAI), *H.H. Chang* 2046 (TAI), *H.Y. Liu* 1749 (TAI), *I. Simozawa* 194, 195 (TAI), *J.J. Chen* 232 (TAI), *J.Y. Hwang & C.Y. Hwang* 30 (TAI), *J.W. Sheu* 740 (TAI), *K.C. Yang* 2298 (TAI), *M.L. Weng* 229, 663, 730, 1930, 1966, 3399, 3428 (TAI), *M. Ogata* 2 (BM), *M. Tagawa* 1218, 1530 (P), *M. Tagawa* 1237, 3497 (BM, K), *M. Tagawa* 1425 (BM), *M. Tagawa* 1942, 3292 (K, P), *M. Tagawa* 2111 (BM), *Nakamura-Taizo* 4843 (TAI), *P.H. Lee* 3422, 3489 (TAIF), *P.H. Lee, L.S. Kuo* 3272, 3280, 3289 (TAIF), *P.F. Lu* 5503, 6417, 8013, 8040, 8835, 8848, 10273, 12771, 27498, 27540, 27707, 27826, 27957, 27967, s.n. (TAIF), *S.M. Ku* 1499 (TAIF), *S. Sasaki* 380102, s.n. (TAI), *S. Suzuki* 1980, 4954a, s.n. (TAI), *Suzuki-Tokio* 13278, 20923 (TAI), *S.W. Chung* 6804 (TAIF), *S.Y. Peng* s.n. (TAIF), *T.Y. Chiang* 21650, 26299, 26957 (TAI), *Y.C. Jeng* 2746 (TAI), *Y. F. Chen* 6483 (TAI), *Y.H. Chang* 20130206-017, 20130929-008 (TAIF), *Y.H. Chang* 962 (TAI), *Y.H. Tzeng* 964 (TAIF), *Y.J. Lai, W.H. Wu, C.H. Yu, L.C.K.* 1051 (TAI); **LAOS**: *Poilane* 2382 (BM); **VIETNAM**: *H. Christ* 1829 (E); **MALESIA**: **Sumatra**, *Teschewacher* 19, 22 (K); **Philippines**, **Luzon**, *A.D.E. Elmer* 8573 (B, K), *Copeland* 1899 (K, MICH), *M. G. Price* 1591, 1831 (K).

8. *Tectaria crenata* Cav., Fl. Descr, pl.: 250. 1802; C. Chr., Dansk Bot. Ark. 9: 3, 14. 1937; Tardieu & C. Chr., Fl. Indo-Chine 7(2): 407. 1941; C. Chr., Bulletin 177: 102. 1943; Holttum, Rev. Fl. Malaya ed. 1, 2: 510. 1955 [‘1954’]; St John, Occas. Pap. Bernice P. Bishop Mus. 21: 190, f. 5, 6. 1954. Tagawa & K. Iwats., S. E. Asian Stud. 5: 98. 1967; Brownlie, Pterid. Fl. Fiji: 298. 1977; Tagawa & K. Iwats., Fl. Thailand 3(3): 372. 1988; Holttum, Fl. Males., Ser. 2, Pterid. 2: 80. 1991; I.M. Turner, Gard. Bull. Singapore 47(1): 54. 1995; Boonkerd & Pollawatn, Pterid. Thailand: 212. 2000; S. Linds., D.J. Middleton, Boonkerd & Suddee, Thai For. Bull., Bot. 37: 98. 2009; Brownsey & Perrie,

- Teloepa 13(3): 535. 2011. Type: Mariana Islands, *Née* s.n. [lectotype (designated here) MA! (photo seen MA213020-2); isolectotypes BM! (BM001048597), MA! (photo seen MA213019)].
- Aspidium tectaria* Desv., Mém. Soc. Linn. Paris 6: 245. 1827. *nom. superfl.* Type: as for *T. crenata*.
- Aspidium crenatus* (Cav.) Ching, Bull. Fan Mem. Inst. Biol., Bot. 10(5): 237. 1941; Edgar Heim, Flora and Vegetation of Bali Indonesia: An Illustrated Field Guide: 38, f. 37. 2015. Type: as for *T. crenata*.
- Aspidium repandum* Willd., L., Sp. Pl. 5: 216. 1810; Mett., Farngett. 4: 126. 1858. Type: Philippines, *Willdernow* 19734 [lectotype (designated here) B! (B-W-19734-01 1), isolectotype B! (B-W-19734-01 2), photo BM!].
- Tectaria repanda* (Willd.) Holttum, Fl. Males., Ser. 2, Pterid. 2: 80. 1991. Type: as for *A. repandum*.
- Aspidium pachyphyllum* Kunze, Bot. Zeitung (Berlin) 6: 259. 1848; Mett., Fil. Hort. Bot. Lips.: 95, t. 21. 1856; Hook., Sp. Fil. 4: 56. 1862. excl. syn.; Bedd., Suppl. Ferns Brit. Ind.: 46. 1892; C.V. Morton, Contr. U.S. Natl. Herb. 38: 349. 1974. — Type: Java, *Zollinger* 580 [lectotype L (*n.v.*), photo BM!, P! (photo seen P01486172)].
- Aspidium grandifolium* C. Presl, Epim. Bot.: 64. 1851; Holttum, Novit. Bot. Delect. Seminum Horti Bot. Univ. Carol. Prag. 1968: 27. 1969. Type: Philippines, Panay, *Cuming* 356 [holotype PRC; isotypes: BM!, K! (K000360305, K000360306, K000360307), photo BM!, K! (K000360303)].
- Tectaria grandifolia* (C. Presl) Copel., Philipp. J. Sci. Bot. 2: 413. 1907; Fern Fl. Philipp.: 314. 1960. Type: as for *A. grandifolium*.
- Aspidium grande* Mett., Farngett. 4: 121. 1858 (non Fée, 1852), *nom. superfl.* Type: as for *A. grandifolium*.
- Aspidium platyphyllum* C. Presl, Epimel. Bot.: 65. 1851, *nom. illeg. hom.* Type: Philippines, Cebu, *Cuming* 340 [holotype PRC, isotypes B! (B 20 0168373, B 20 0168374), BM!, K! (K000360754, K000360755, K000360756, K000360757), P! (photo seen P01486140)].
- Cardiochlaena laevis* Fée, Mém. Foug. 5. Gen. Filic.: 316. 1852. Type: Philippines, *Cuming* s.n. (*n.v.*).
- Cardiochlaena sinuosa* Fée, Mém. Foug. 5. Gen. Filic.: 316. 1852. Type: Philippines, *Cuming* s.n. (*n.v.*).
- Aspidium heptaphyllum* Baker, J. Bot. 17: 246. 1879. Type: Samoa, *Horne* 20 [lectotype (designated here) K! (K000598760), isolectotype K! (K000604532)].
- Tectaria heptaphylla* (Baker) C. Chr., Index Filic. Suppl. 3: 180. 1934. Type: as for *A. heptaphyllum*.
- Aspidium kawakamii* Alderw., Bull. Jard. Bot. Buitenzorg 2, 7: 4. 1912; Malayan Ferns Suppl.: 196. 1917. Type: S Sulawesi, *Kawakami* s.n. (BO).
- Tectaria kawakamii* (Alderw.) C. Chr., Index Filic. Suppl. 3: 180. 1934. Type: as for *A. kawakamii*.
- Polypodium involucratum* Roxb., Calcutta J. Nat. Hist. 4: 491. 1844. Type: Moluccas, Ambon Island, *Roxburgh* 333 [lectotype (designated here) BR! (photo seen BR0000006984922), isolectotype BR! (photo seen BR0000006985257), photo BM!].



*Aspidium persoriferum* Copel., *Fragm. Fl. Philipp.*: 177. 1905. — Type: Philippines, Mindanao, *Copeland* 929 [lectotype (designated here) MICH! (photo seen MICH1190039), photo K! (K000360734, K000360735)].

*Rhizome* short, erect, densely scaly at apex; *scales* basifixed, concolorous, dark brown, 2–4 × 10–20 mm, lanceolate, apex acuminate, margin entire. *Fronde*s monomorphic, lamina unipinnate; stipes stramineous to dull brown, grooved, 40.0–82.0 cm long, covered with short hairs throughout, scaly at base; lamina oblong-ovate, 40.0–70.0 × 25.0–60.0 cm; basal pinnae 12.0–32.0 × 6.0–11.0 cm, sessile, subopposite, oblong-elliptic, apex acuminate, base cuneate, margin entire to slightly crenate, more or less having basiscopic lobe; basal basiscopic lobes 8.0–25.0 × 3.0–5.0 cm, elliptic-oblong, apex acuminate, base acute, margin entire or sometimes slightly crenate; lateral pinnae 3–10 pairs, alternate or subopposite, sessile, 16.0–35.0 × 2.0–7.0 cm, elliptic-oblong, apex acuminate, base cuneate, margin entire or sometimes slightly crenate, interval 7.0–9.0 cm; terminal pinna 15.0–30.0 × 15.0–25.0 cm, elliptic-ovate, apex acuminate, base cuneate to attenuate, margin trilobed to pinnatifid, lobes elliptic-oblong, apex acuminate, margin subentire; chartaceous, glabrous on upper surface except few short hairs on sinus, midrib and main veins, pubescent on lower surface, covering with short brown hairs on lamina and densely hairy on midrib and main veins, vein fully anastomosing forming irregular areoles and areolules with free included veinlets, veinlets free, forked in sterile fronds and simple in fertile fronds, costal areoles having free included veinlets, forked in sterile fronds and simple in fertile fronds. *Sori* round, large, one in each areole, terminal on free included veinlets, arranged in two rows between main veins; indusia round-reniform, brown, dorsifixed, persistent. **Fig. 4.8.**

Thailand.— SOUTH-EASTERN: Trat (Ko Chang); PENINSULAR: Surat Thani (Khao Nong), Nakhon Si Thammarat (Khao Luang National Park, Khao Nan National Park), Trang (Khao Chong), Yala (Betong).

Distribution.— Vietnam, Malesia [Peninsular Malaysia, Sumatra, Java, Bali, Borneo, Philippines (Luzon, Mindanao), Waigeo Island, New Guinea], Mariana Islands (type), Caroline Islands, Guam, Palau, Papua New Guinea, Solomon Islands, Fiji, Wallis and Futuna, Samoa, Vanuatu, New Hebrides.

Ecology.— Terrestrial on humus rich mountain slopes near stream banks in dense evergreen forest at 600 – 1,100 m alt.

Specimens examined.— **THAILAND:** Nakhon Si Thammarat, Khao Luang, 720–950 m, 22 Aug. 1967, *K. Iwatsuki, H. Koyama, M. Hutoh & A. Chintayungkun* T-14552 (BKF); Trang, Khao Chong, 600–1,100 m, 27 Jan. 1966, *M. Tagawa, K. Iwatsuki & N. Fukuoka* T-6807 (BKF); Yala, Betong, Dao Dueng Waterfalls, 900 m, 24 May 1993, *T. Boonkerd* 1166 (BCU); Nakhon Si Thammarat, Khao Nan National Park, *T. Boonkerd, Y. Sirichamorn & C. Sanguansab* 209 (BCU);

**VIETNAM:** *Eberhardt* 373 (P), *Gaudichaud* s.n. (P); **MALESIA:** **Peninsular Malaysia,** *C.G. Matthew* s.n. (K), *Dr. King's Collector* 1816 (K), *Dr. King's Collector* 2347 (B, K), *Dr. King's Collector* 6305 (B, K, P), *I.H. Burkill, R.E. Holttum* 8849 (P), *M. Nur* 11006 (P), *R.E. Holttum* 10958 (P), *R.H. Yapp* 577 (K), *Scortechini* s.n. (K, P), *Zollinger* 1669 (L); **Sumatra,** *A.H.G. Alston* 13987 (BM), *C.J. Brooks* 445S (BM), *C.J. Brooks* 15868 (BM), *C.G. Matthew* s.n. (K), *D. Vriese* 76 (K), *Korthals* s.n. (P), *Winkler* 148 (P); **Borneo,** *Bau* 10843 (L), *B.S. Parris* 6641, 11437 (K), *B.S. Parris, J.P. Croxall* 9086 (K), *C. Hose* 43/53 (BM), *Dr. E. Mjoberg*

25 (BM), *G. Creagh* s.n. (K), *J. & M.S. Clemens* 26931, 29411 (K), *J. & M. S. Clemens* 31137, 33977 (BM), *J.A.R. Anderson* 9079 (L), *Native collector* 2506 (P), *W.L. Chew, E.J.H. Corner, A. Stainton* 1186 (K); **Java**, *Blume* s.n. (P), *C. Holstvoogd* 558 (L), *D. Vriese* 288 (K), *D. Vriese* s.n. (P), *E. Graeffe* 105 (P), *Hochreutiner* 1722 (L), *J.A. Lörzing* 2585 (K, L), *J.H. Kern* 8501 (L), *J.H. Kern* 8521 (K, L), *J. & M.S. Clemens* 26931 (BM), *Konden* 14923 $\beta$  (L), *M. Enoch* 241 (L), *Miquel* s.n. (K), *M. Raciborski* s.n. (K, L), *Mousset* 23 (P), *Mousset* 46 (K, L, P), *Mousset* s.n. (BM), *R.W. Hullett* s.n. (BM), *Teijsmann* 14138 (BM), *Wallich* s.n. (L), *Zollinger* 580 (BM (photo), L, P (photo)), *Zollinger* 2287 (L), *Zollinger* 2434 (BM, L); **Lesser Sunda Islands**, *A.H. Everett* s.n. (BM), *Father J.A.J. Verheijen* 3722 (L), *Fr. E. Schmutz* SVD 5734 (L), *F.I. Rensch* s.n. (B), *Kostermans* 18393, 18840 (L), *Kostermans & Wirawan* 746 (L), *Kostermans & Wirawan* 844 (K, L), *Kds.* 17131 $\beta$ , 17069 $\beta$ , 17114 $\beta$  (L), *O. Jaszg* 1861 (L), *P.E. Schutz* 25 (L); **Sulawesi**, *A.H.G. Alston* 16468 (BM), *D. Darnaedi* 2104 (K), *E. Hennipman* 5194 (K, L), *E. Hennipman* 5562, 5623 (L), *E. Hennipman* 6132 (K), *Savinierre* 54 (K, P); **Philippines, Luzon**, *A.D.E. Elmer* 6171 (K, P), *A.D.E. Elmer* 16319 (BM, K, P), *A.D.E. Elmer* 17010, 17855 (BM), *A.D.E. Elmer* s.n. (K), *C.M. Weber* 1545 (P), *Cuming* 224 (K), *Cuming* s.n. (BM, P), *D.R. Mendoza* PNH 17199 (K), *E. Fénix* 12956 (P), *F. Otanes* 17673 (K, L, P), *H. Cuming* 183 (K), *H.M. Curran, M.L. Merritt* 15776 (P), *Madulid et al.* 846 (L), *M. Ramos* 7172 (P), *M. Ramos* 7178 (L), *M. Callery* s.n. (P), *M.G. Price* 661, 666, 720, 753, 917, 1086, 1163, 1367, 1382, 1397, 1699, 1915, 1923, 2227, 2232, 2242, 2318, 2334, 3006, 3103 (K), *M. Vanoverbergh* 2160, 2601a, 2601b, 2601c (P), *M. Ramos* 13888, 27581 (P), *M. Ramos* 33246 (K, P), *Vidal* 1904 (K); **Mindoro**, *J. Whitehead* s.n. (BM); **Paney**, *Cuming* 356 (K (photo & specimens)), *G.S. Jenman* 172 (K); **Leyte**, *C.A. Wenzel* 459 (BM, P), *C.A. Wenzel* 1741 (BM), *G. Frohne* PNH 35655 (L); **Cebu**, *Cuming* 340 (BM, K, P); **Samar**, *Cuming* 339 (K), *G. Edaño* 24839, 24843 (P), *Guturreg et al.* 535 (L), *M.G. Price & B.F. Hernaez* 64, 959 (K), *P. Bartsch* 352 (P); **Mindanao**, *A.D.E. Elmer* 10966 (BM, K, L, P), *Cuming* 290 (K), *E.B. Copeland* 1967, s.n. (P), *E. Fénix* 15729, 26145 (P), *L. Escritor* 21381 (P), *M.G. Price* 2746 (K); **Moluccas**, *A.H.G. Alston* 16668 (BM), *B.S. Parris* 11113, 11126 (K), *C.J. Brooks* 17599 (BM), *D.R. Pleyte* 113 (L), *E. Stresemann* 216 (L), *G.E. Edaño* PNH 12611 (BM), *J.E. Teijsmann* 76 (K), *K. Iwatsuki, M. Kato, K. Ueda & U.W. Mahjar* A-40 (K), *M. Kato, B. Sunarno and H. Akiyama* C-4703 (K), *P. Buwalda* 5912 (L), *P.J. Eyma* 2391 (K, L), *P.M. Taylor* (NM-II) P-305 (K), *R.F. Ellen* 1216 (K), *Roxburgh* 333 (BR), *Webb* s.n. (K); **Waigeo Island**, *P. van Royen* 5151 (BM, L); **New Guinea**, *M.J.S. Sands* 6690 (K, L), *R.J. Johns* 7649 (K); **MARIANA ISLANDS**: *Née* s.n. (BM, MA); **CAROLINE ISLANDS**: *M. Takamatsu* 520 (K), *Ledermann* 13707 (K); **GUAM**: *A. Rinehart* LR 14854 (K); **PALAU**: *M. Balick, S. Dahmer, Y. Desmond, A. Kitalong, C. Kitalong, R. Lee, N. Penna, K. Soaladaob* 4517 (NY); **PAPUA NEW GUINEA**: *A. Floyd* NGF 7010 (L), *A. Millar & A. Dockrill* NGF 12083 (BM, L), *Bamler* 191 (B, P), *Bamler* 194 (B), *B.S. Parris & J.P. Croxall* 4810 (K), *C. Versteegh* BW 10256 (L), *C. King* 409 (BM), *C. Ridsdale & P. Lavarack* NGF 31602 (BM), *E.E. Henty* NGF 38535 (BM), *E.E. Henty & M.J.E. Coode* NGF 29224 (BM), *H.J. Gay* 789 (K), *H.J. Lam* 7792 (L), *H. Streimann & P. Katik* NGF 28655 (K, L), *Ir.H.A.v.d. Sijde* BW 4157 (L), *J.R. Croft* 425 (L), *J. R. Croft et al.* LAE 68605 (L), *J.R. Croft et al.* LAE 68905, 65860 (BM, L), *J.R. Croft* LAE 68322 (L), *J.S.W.* 3741A (L), *K. Damas* 14 (K, L), *K. Rau* RAU 455, 465 (K, L), *L.E.*

*Cheesman* s.n. (BM), *L.J. Brass* 12222 (BM, L), *L.J. Brass* 23462 (BM), *Main* 384 (L), *M. Coode*, *T. Cropley* & *P. Katik* NGF 29764 (BM), *Native Collector* 5612 (L), *N.A. Wakefield* 1390 (BM), *R.D. Hoogland* 4511 (BM, L), *R.J. Brass* 31930 (L), *R. Pullen* 689 (L), *R. Pullen* 1779 (L), *T.G. Hartley* TGH 11017 (L), *T.G. Walker* T. 9051, T. 9154, T. 9265, T. 9298-9, T. 9548 (BM), *W. Takeuchi* 7388 (K); **BISMARCK ARCHIPELAGO: Admiralty Islands**, *M.J.S. Sands*, *G.A. Pattison* & *J.J. Wood* SANDS 2979 (L); **New Ireland**, *A.C. Jermy* 7790 (BM), *J. McGillivray* s.n. (K), *J.R. Croft* 1984, 2083 (K, L); **SOLOMON ISLANDS: C.W. Chen**, *T.C. Hsu*, *M. Fanerii* SITW03589, SITW03786, SITW05035 (TAIF), *J.M. Hu*, *C.H. Hung*, *K.K. Koo* SITW02804 (TAIF), *J.H.L. Waterhouse* s.n. (K), *Richards* s.n. (K), *Y.H. Chang*, *W.H. Wu*, *C.F. Chen* SITW01973 (TAIF), *Y.H. Chang*, *W.H. Wu*, *C.F. Chen*, *M. Fanerii* SITW02587, SITW02588, SITW02589 (TAIF); **FIJI: A.C. Smith** 6310 (K, P), *A.C. Smith* 8729 (K), *G. Brownlie* 1889 (K), *H.E. Parks* 20015 (P), *H.E. Parks* 20136, 20323, 20324 (P), *J. Horne* 418 (K), *O. Degener* 15282 (P); **WALLIS AND FUTUNA: Futuna Island**, *Frimigacci* & *Siozat* s.n. (P), *W. Fasken* 216 (BM); **SAMOA: E. Betsch** 75 (P), *E. Graeffe* 14 (BM), *Horne* 20 (K), *K.u.L. Reching* 140 (BM), *W.A. Sledge* 1547 (K); **VANUATA: A.F. Braithwaite** RSNH 2198 (K), *Dr. A. Morrison* s.n. (K), *G. Rouhan* 714 (P), *J. Braithwaite* 63 (P), *J.M. Gillivray* 880 (K), *L. Bernardi* 12993 (K), *J. MacGillivray* s.n. (K), *Milne* 353 (K), *M. Pignal* 2857 (P), *Mueller Pat Curry* 383 (K), *S. Efate* s.n. (P), *Woods* 29 (BM, P).

**9. *Tectaria decurrens*** (C. Presl) Copel. in *Elmer*, *Leafl. Philipp. Bot.* 1: 234. 1907; *Ching*, *Sinensia* 2(2): 22. 1931; *Holtum*, *Gard. Bull. Singapore* 9: 137. 1937; *Backer* & *Posth.*, *Varenfl. Java*: 73. 1939; *Tardieu* & *C. Chr.*, *Fl. Indo-Chine* 7(2): 406. 1941; *C. Chr.*, *B.P. Bishop Museum Bulletin* 177: 102. 1943; *Dickason*, *Ohio J. Sci.* 46(3): 121. 1946; *Copel.*, *Philipp. J. Sci.* 77(4): 419. 1949; *Fern Fl. Philipp.*: 315. 1960; *Holtum*, *Dansk Bot. Ark.* 23: 242. 1965; *Molesworth Allen*, *Gard. Bull. Singapore* 22: 177, with photo. 1967; *Tagawa* & *K. Iwats.*, *S. E. Asian Stud.* 5: 99. 1967; *Holtum*, *Rev. Fl. Malaya*, ed. 2, ed. 2.2: 635. 1968; *Sledge*, *Kew Bull.* 27: 420. 1972; *Nayar* & *Kaur*, *Comp. Bedd., Handb.*: 51. 1974; *Nakaike*, *Enum. Pterid. Japon. Fil.*: 261. 1975; *Brownlie*, *Pterid. Fl. Fiji*: 291, pl. 32, 1. 1977; *Holtum*, *Gard. Bull. Singapore* 34(1): 139. 1981; *Sledge*, *Bot. J. Linn. Soc.* 84: 18. 1982; *Dixit*, *Census*: 143. 1984; *C.M. Kuo*, *Taiwania* 30: 29. 1985; *Chandra* & *Kaur*, *Nomen. Guide*: 9. 1987; *Tagawa* & *K. Iwats.*, *Fl. Thailand* 3(3): 372. 1988; *Holtum*, *Fl. Males.*, *Ser. 2, Pterid.* 2: 90. 1991; *J. L. Tsai* & *W.C. Shieh*, *Fl. Taiwan*, ed. 2: 297. 1994; *I.M. Turner*, *Gard. Bull. Singapore* 47(1): 54. 1995; *Boonkerd* & *Pollawatn*, *Pterid. Thailand*: 212. 2000; *S.G. Lu* & *T.Y.A. Yang*, *Taiwania* 50(2): 158. 2005; *S. Linds.*, *D.J. Middleton*, *Boonkerd* & *Suddee*, *Thai For. Bull., Bot.* 37: 98. 2009; *Brownsey* & *Perrie*, *Telopea* 13(3): 535. 2011; *Dey et al.*, *J. Taxon. Biodiv. Res.* 5: 34. 2011; *F.W. Xing*, *Y.H. Yan*, *S.Y. Dong*, *F.G. Wang*, *Christenh.* & *Hovenkamp*, *Fl. China* 2-3: 735, f. 1022, 5-7. 2013. Type: Philippines, Luzon, *Haenke* s.n. [holotype PRC, photo BM! (BM000527784), K! (K000360351)].

*Aspidium decurrens* C. Presl, *Rel. Haenk.* 1: 28. 1825; *Kunze*, *Bot. Zeitung (Berlin)* 4: 462. 1846; *Bedd.*, *Handb. Ferns Brit. India*: 219, f. 113. 1892; *Alderw.*,

- Malayan Ferns: 247. 1908; Holttum, Novit. Bot. Delect. Seminum Horti Bot. Univ. Carol. Prag. 1968: 9. 1969. Type: as for above.
- Sagenia decurrens* (C. Presl) T. Moore, Index Filic.: 86. 1857; Racib., Pteridoph. Buitenzorg: 196. 1898. Type: as for *A. decurrens*.
- Nephrodium decurrens* (C. Presl) Baker, Syn. Fil. 299. 1867; Clarke, Trans. Linn. Soc. London, Bot. 1: 539. 1880. Type: as for *A. decurrens*.
- Aspidium pteropus* Kunze, Bot. Zeitung (Berlin) 4: 462. 1846, *nom. nud.*; Mett., Farngett. 4: 120. 1858. Type: Philippines, Luzon, *Cuming* 148 [holotype RB! (photo seen RB00543243), isotypes BM!, K! (K000360357, K000360358, K000360359, K000360360), L!, LE! (photo seen LE00008310, LE00008311), MICH! (photo seen MICH1259574), SING!, US! (photo seen US00624173, US00624174), Z].
- Sagenia pteropus* (Kunze) T. Moore, Index Filic.: 89. 1858; Bedd., Ferns S India: pl. 82. 1863. Type: as for *A. pteropus*.
- Cardiochlaena alata* Fée, Mém. Foug. 5. Gen. Filic.: 315. 1852, *nom. superfl.* Type: as for *A. pteropus*.
- Sagenia mamillosa* T. Moore, Ill. Hort. 4(6): pl. 598. 1856. Type: cult. ex Moluccas, *s. coll. s.n.* [holotype K! (K000236988)].
- Aspidium decurrens* C. Presl var. *mamillosum* (T. Moore) Alderw., Malayan Ferns: 247. 1908. Type: as for *S. mamillosa*.
- Aspidium heterodon* Copel. in Perkins, Fragm. Fl. Philipp.: 177. 1905, *non* Blume. 1828, *nom. illeg.* Type: Philippines, Mindanao, *Copeland* 951 [holotype MICH! (photo seen MICH1190032), photo K! (K000360349)].
- Aspidium copelandii* C. Chr., Index Filic.: 661. 1906. Type: as for *A. heterodon*.
- Aspidium alatum* Ridley, Trans. Linn. Soc. Lond. 9: 225. 1916, as '*Asplenium alatum*', *non* Hook. & Grev., 1831. Type: W New Guinea, Mt Carstensz Exp., *C. Boden Kloss* s.n. [holotype K! (K000361030), isotype K! (K000361031)].
- Aspidium ridleyanum* Alderw., Malayan Ferns: 505. 1917. Type: as for *A. alatum*.
- Tectaria ridleyana* (Alderw.) C. Chr., Index Filic. Suppl. 3: 184. 1934. Type: as for *A. alatum*.
- Aspidium macrophyllum* sensu auct. Blume (non Sw., 1806), Enum. Pl. Javae: 144: 1828.

*Rhizome* short, erect, scaly; *scales* basifixed, bicolored, light brown to dark brown centrally with paler brown ferruginous edges, 5–6 × 1–1.5 mm, oblong-lanceolate, apex acute, margin minutely toothed. *Fronde*s monomorphic, lamina pinnatifid; stipes stramineous to dull brown, grooved adaxially, 40.0–70.0 cm long, winged nearly to the base, wing 1.0–2.2 cm wide, becoming narrower towards base, scaly at base, somewhat throughout; lamina 28.0–50.0 × 16.0–35.0 cm, oblong-ovate in outline, rachis winged throughout; basal pinnae 14.0–28.0 × 3.0–12.0 cm, elliptic-oblong, apex acute to acuminate, margin entire or sometimes crenate, more or less having basispic lobe, basispic lobe 3.0–10.0 × 1.5–3.0 cm, elliptic-lanceolate, apex acuminate, margin entire; lateral pinnae 1–3 pairs, 14.0–30.0 × 3.5–6.5 cm, lanceolate-oblong, apex acuminate, margin entire or sometimes crenate; terminal pinna trilobed, bearing a large middle lobe and smaller adjacent two lobes, 20.0–25.0 × 13.0–18.0 cm, ovate-lanceolate in outline, apex acuminate, margin entire or crenate; texture papyraceous, deep green, glabrous on both surfaces except few short hairs on midrib or main veins beneath, venation anastomosing to form many areoles and

areolules with free included veinlets, veinlets simple or forked, costal areoles more or less having free included veinlets. *Sori* round, terminal on included veinlets, arranged in two rows between main veins, rather deeply impressed on abaxial surface of lamina; indusia round-reniform, peltate, stiff, persistent. **Fig. 4.9.**

Thailand.— NORTHERN: Chiang Rai (Doi Luang National Park, Lam Nam Kok National Park), Phrae [Rong Kwang (Mae Sai)], Phitsanulok (Thung Salaeng Luang National Park); SOUTH-EASTERN: Prachin Buri [Na Di (Bu Phram)], Trat (Khlong Kaew National Park); SOUTH-WESTERN: Kanchanaburi (Kroeng Krawia Waterfalls), Phetchaburi (Kaeng Krachan National Park); PENINSULAR: Surat Thani (Khlong Phanom National Park), Nakhon Si Thammarat (Khao Luang National Park, Khao Nan National Park), Yala (Bang Lang National Park, Betong).

Distribution.— Sri Lanka, Bangladesh (Chittagong), India (Assam), China (Yunnan, Guizhou, Guangxi, Hainan, Hunan, Guangdong, Hong Kong, Fujian, Taiwan), Japan (Ryukyu Islands), Myanmar (Tuang), Laos (Xayaburi, Vientiane), Vietnam, Malesia [Peninsular Malaysia, Sumatra, Java, Borneo, Sulawesi, Philippines [Luzon (type), Mindoro, Samar, Leyte, Panay, Palawan, Negros, Siargao Islands, Mindanao], Moluccas, New Guinea], Papua New Guinea, Bismarck Archipelago (Admiralty Island, New Britain, New Ireland, Misima Island), Solomon Islands, Vanuatu (New Hebrides), Fiji, Samoa, Cook Islands, Society Islands (Tahiti).

Ecology.— Terrestrial fern on moist mountain slope or along streamlet bank in shady places of dense evergreen forest at 100–850 m alt.

Uses.— Ornamental plants.

Note.— This species rarely exhibit simple entire lamina. Holttum (1991b) also noted that *T. decurrens* has unlobed linear fronds of about 30 cm long in some Malesian specimens. I found only one Chinese specimens with simple entire lamina.

Specimens examined.— **THAILAND:** Prachin Buri, Na Di, Bu Phram, c 500 m, 4 Jan. 1925, *A.F.G. Kerr* 9837 (BK, BM, K); Surat Thani, Khlong Phanom National Park, c 100 m, 27 Feb. 1930, *A.F.G. Kerr* 18306 (BK, BM, K); Phetchaburi, Kaeng Krachan, Kaeng Krachan National Park, Downhill from Khao Phanoen Thung ranger unit substation, on way to Than Thip Waterfalls, 12° 49' N 99° 21' E, 850 m, 14 Dec. 2002, *D.J. Middleton, S. Suddee & C. Hemrat* 1639 (BKF); Trat, Bo Rai, Khlong Kaew National Park, Than Hin Dat Waterfalls, 12° 42.5' N 102° 29.3' E, 425 m, 8 Jan. 2009, *D. J. Middleton, P. Karaket, S. Lindsay, T. Phutthai and S. Suddee* 4648 (E); Nakhon Si Thammarat, Nopphitum, Khao Luang National Park, Krung Ching Waterfalls, 8° 43' 15" N 99° 40' 13" E, 210 m, 24 Sep. 2010, *D. J. Middleton, P. Karaket, S. Lindsay, T. Phutthai & S. Suddee* 5522 (E, PSU); Chiang Rai, Lam Nam Kok National Park, 400 m, 23 Sep. 1967, *K. Iwatsuki, N. Fukuoka, M. Hutoh & D. Chaiglom* T-10890 (BKF); Chiang Rai, Lam Nam Kok National Park, 400 m, 23 Sep. 1967, *K. Iwatsuki, N. Fukuoka, M. Hutoh & D. Chaiglom* T-10928 (BKF); Kanchanaburi, Thong Pha Phum, Kroeng Krawia Waterfalls, 250 m, 4 Feb. 1962, *K. Larsen* 9554 (BKF, E, K); Nakhon Si Thammarat, Khao Luang National Park, Krung Ching Waterfalls, 9 Feb. 2000, *K. Sookpong* 3 (PSU); Phitsanulok, Thung Salaeng Luang National Park, c 300–600 m, 12 Dec. 1965, *M. Tagawa & N. Fukuoka* T-2100 (BKF); Yala, Betong, Bang Lang National Park, Ban Chulaphon Phattana 10, 5.511900 N 101.147700 E, 600 m, 19 Jul. 2004, *R. Pooma, K. Phattarahirankanok, S. Sirimongkol M. Poopath, S. Sangrit* 4448 (BKF); Nakhon Si Thammarat, Khao Luang, c 800 m, 22 Jan. 1966, *M. Tagawa, K. Iwatsuki & N. Fukuoka* T-5309 (BKF);

Chiang Rai, Phan, Doi Luang National Park, Pu Kaeng Waterfalls, 450 m, 5 Dec. 2015, *S. Wongphakdee* 2015-2 (BCU); Yala, Betong, Ban Phu Khao Thong, 600 m, 24 May 1993, *T. Boonkerd* 1178 (K); Chiang Rai, Phan, Doi Luang National Park, 450 m, 18 Jan. 1996, *T. Boonkerd* 1573 (BCU); Nakhon Si Thammarat, Khao Nan National Park, Huai Lhek, 7 Apr. 2006, *T. Boonkerd*, *S. Chantanaorrapint* & *W. Khwaiphan* 65 (BCU); Nakhon Si Thammarat, Khao Nan National Park, Krung Nang Waterfalls, 10 Apr. 2006, *T. Boonkerd*, *S. Chantanaorrapint* & *W. Khwaiphan* 222 (BCU); Phrae, Rong Kwang, Mae Sai, 620 m, 27 Nov. 1922, *Winit* 966 (BKF);

**SRI LANKA:** *Beddome* s.n. (K), *C.G. Matthew* s.n. (K), *Chevalier* 44217 (BM), *C.R. Fraser-Jenkins*, *P. Jayasekara* 118 (K), *F. Schmid* N. 1141 (BM), *G. Gardner* 46 (BM), *Gondner* 1088, 1355 (K), *G. Wall* 44/217 (BM), *H.F. Hance* 194 (BM), *H. Witte* s.n. (L), *James Macrae* 366, 869 (BM), *John Smith* 59 (BM), *M. Skinner* s.n. (K), *Rawson W. Rawson* 3251 (BM), *R.B. & A.J. Faden* 76/305 (K), *R. Brown* s.n. (BM), *T.G. Walker* T299, T300 (BM), *Thwaites* CP 1355 (BM, K), *W.A. Sledge* 581 (BM, K), *W.A. Sledge* 960 (K), *W.A. Sledge* 1359 (BM), *Walker* s.n. (K), *W. Robinson* s.n. (K); **BANGLADESH: Chittagong**, *C.B. Clarke* 8249, 8272D (K), *C.B. Clarke* 19682B (BM), *C.B. Clarke* 19691 (BM, K), *G. D. H. & J. J.* 476, s.n. (K), *J. S. Gamble* 7812, 7838 (K); **INDIA: C.B. Clarke** 40755, 40756 (K), **Assam**, *A. Simons* 226 (K), *Griffith* 1709 (BM), *Griffith* s.n. (K), *G. Mann* s.n. (BM), *J.F. Duthie* s.n. (K), *R.H. Beddome* 217 (BM), *R.L. Keenan* s.n. (K); **CHINA: Yunnan**, *J.F. Rock* 2517 (K), *T. Santisuk et al.* 106 (BKF); **Guangxi**, *R.C. Ching* 7546 (PE); **Hainan**, *C. I. Lei* 266 (K, PE), *C. Wang* 33576, 34545, 36307 (PE), *F.A. McClure* 8165 (K), *H. Fung* 20134 (BM, K, PE), *H.Y. Liang* 64687 (PE), *W.T. Tsang* 15975, 16190 (K), *W.T. Tsang* 17286 (K, PE); **Guangdong**, *H.Y. Liang* 60719 (PE), *K.K. Tsoong* 985 (PE), *S.P. Ko* 50554 (PE), *S.Y. Lau* 20230 (PE), *W.T. Tsang* 15975 (PE); **Hong Kong**, *C. Ford* s.n. (K); **Taiwan**, *C.C. Hsu* 13130 (TAI), *C.E. Chang* 9014 (TAI), *C.S. Kuoh* s.n. (TAI), *C.W. Chen* Wade192, Wade193, Wade194, Wade195, Wade989, Wade4147, Wade4480 (TAIF), *C.W. Chen*, *T.C. Hsu*, *M. Fanerii* SITW03956, SITW05034 (TAIF), *C.C. Hsu* s.n. (K), *C.C. Hsu et Kuoh* 13130 (TAI), *C.C. Yang* 12 (TAI), *C.I. Peng* 1543 (TAI), *C.M. Kuo* 210, 450, 1566, 1996, 5325, s.n. (TAI), *C.S. Kuoh* 4130 (TAI), *C. Welferd* 474 (K), *Do* 209 (TAI), *E. Matsuda* s.n. (TAIF), *F.C. Ho* 1483 (TAIF), *G. Masamune* s.n. (TAI), *H.L. Chiang* 2633 (TAIF), *H. Shimizu* s.n. (TAI), *I. Simozawa* 207, 208, 210 (TAI), *J.C. Wang* 208 (TAIF), *J.H. Lii* 1526 (TAIF), *K.J. Tang* 855 (TAIF), *K.Y. Li* 717 (TAIF), *Kuo et Yu* 14347, 14372, 14825 (TAI), *K.C. Yang*, *Y.H. Chen* s.n. (TAIF), *L, K et al.* 512 (TAI), *L.Y. Chen* 1337 (TAI), *M.F. Kao* 1243, 2708, 3163 (TAI), *M.F. Kao*, *C.M. Kuo & M.C. Hsu* 2628 (TAI), *M.H. Huang* mh0463 (TAIF), *M.J. Jung* 0054, 3115 (TAIF), *M.L. Weng* 90, 91 (TAI), *M. Tagawa* 938 (BM), *P.F. Lu* 520, 637, 984, 2373, 2772, 8290, 10775, 11011, 11125, 12863, 15340, 23711, 25618, 26078, 26294, s.n. (TAIF), *P.H. Lee* 1028, 1073 (TAIF), *R. Oldham* 40 (BM, K), *S.C. Wu*, *J.H. Lii et al.* 1395 (TAIF), *S.F. Huang* 2690, 3114 (TAI), *S.J. Yang* 28790 (TAIF), *S. Sasaki* s.n. (TAI), *S.W. Chung* 5289 (TAIF), *T.C. Huang* 7556 (TAI), *T.C. Huang et al.* 9260, 9501 (TAI), *T.C. Huang & M.T. Kao* 5440, 6317 (TAI), *T.C. Huang*, *S.F. Huang*, *K.C. Yang*, *S.S. Jeng* 10518a (TAI), *T. C. Huang*, *Yang*, *Kao*, *Tang & Chen* 9405 (TAI), *T.T. Chen et al.* 5516, 10330, 10553 (TAIF), *T.Y. Chiang* 22464 (TAI), *T.Y. Yang* 104, 248 (TAI), *U. Faurie* 8012, 8252 (TAI), *W. Hancock* 94 (BM, K), *W. Hancock* s.n. (K), *W.H. Wu* Wu1104 (TAIF), *W.L. Chiou* 561, 1937, 11213, 14805, s.n. (TAIF), *Y.H. Chang*

20080815-010, 20081104-001, 20090814-024, 20100917-021, 20111129-004, 3081 (TAIF), *Y.C. Lu & Y.W. Sang* 1493 (TAIF), *Yung, H. Chen, K. Chengang et al.* s.n. (TAIF), *Y.H. Chang* 959 (TAI), *Y. Yamamoto* s.n. (TAD); **JAPAN: Ryukyu Islands**, *C. Wright* s.n. (K), *F.W. Li* FWL710 (TAIF), *H. Koyama, N. Fukuoka & M. Kato* 855 (K), *K. Yasuda* 0215, 2840 (K), *L.Y. Kuo, F.W. Li, Y.S. Chao, W.H. Wu, S.Y. Hsu, Y.M. Huang* 292 (TAIF), *M. Furuse* 951, 2249, 2502, 2605, 3390, 4034 (K), *M. Furuse* 3102 (PE), *T. zentaro* s.n. (TAIF); **MYANMAR: J.F. Maxwell** 75-307 (BK), **LAOS: Xayaburi**, *J.F. Maxwell* 12-131 (CMUB); **Vientiane**, *J.F. Maxwell* 99-192 (CMUB); **VIETNAM: B. Balansa** s.n. (K), *Cadiere* 85 (K), *M.E. Colani* 3379 (BM), *M. Poilane* s.n. (PE), *Novimliu* 3403 (P), *Poilane* 10942 (PE), *W.T. Tsang* 30256 (K); **MALESIA: Peninsular Malaysia**, *A. Vesterdal* 15 (BM), *B. Scortechini* s.n. (BM), *L.B.M. Allen* 4486 (K), *W. Avé* 291 (L); **Sumatra**, *Ajoeb* 241 (L), *C.J. Brooks* 108S., 279S. (BM), *E. Gardette* 536 (K), *H. C. Robinson and C. B. Kloss* 144 (BM), *J.A. Lörzing* 5531, 12526 (K, L), *J.A. Lörzing* 5705 (K), *Korthals* 430 (L), *M. Jacobs* 8143 (K); **Java**, *Racibosske* s.n. (L); **Borneo**, *A.D. Poulsen* 140 (K), *A. Kostermans* 9516 (K), *B.S. Parris, J.P. Croxall* 8937 (K), *C.G. Matthew* s.n. (K), *C.J. Brooks* s.n. (BM), *D. Wilde, Postar, Tajudin* SAN 143980 (K), *Endert* 2343 (K), *D. L. Topping* 1540 (B), *G. E. Schatz, A. Ibrahim, A. S. Kamariah & B. Rogers* 3274 (K), *H. H. Osman with K. Ariffin* 15678 (K), *H. N. Ridley* s.n. (K), *Hose* s.n. (K), *J. & M. S. Clemens* 26859, 31038 (BM, K), *K. Iwatsuki, M. Kato, G. Murata & Y.P. Moge* B-406 (K), *K. Iwatsuki, M. Kato, M. Okamoto, K. Ueda & E.B. Walujo* B-7339 (K), *Korthals* s.n. (BM, L), *Lobb* s.n. (K), *Low* s.n. (K), *M. Kato, H. Okada, R. Imaichi, H. Tsukaya, Y. Mori, K. Aso & D. Komara* 816 (L), *M.S. Clemens* 10444 (BM), *Richards* 2311 (K), *Sands* 3689 (K), *W. Takeuchi* 6047 (K); **Sulawesi**, *A.H.G. Alston* 16434 (BM, L), *Binnemeyor* 11427 (K), *D. Darnaedi* 2179 (K, L), *D. Hicks* 153 (K), *D. Joncheere* 1006a (BM, L), *D. Joncheere* 1155 (L), *E. Hennipman* 5564 (K, L), *E. Hennipman* 5697 (K, L), *J. T. Johansson, H. Nybom and S. Riebe* 53 (L), *Kds* 16985β (L), *Koorders* 1963 (L); **Philippines**, *C.A. Wenzel* 178 (K, PE), *Cuming* 6 (BKF), *E. Quisumbing* M-50, M-125, M-130, M-183 (K); **Luzon**, *A.D.E. Elmer* 7606, 7932, 7999, 9034 (K, L), *A.D.E. Elmer* 16230 (BM, K, L), *A. D. E. Elmer* 17855 (BM, L), *A. D. E. Elmer* 18170 (L), *Cuming* 148 (BM, K, L, LE, MICH, RB, SING, US, Z), *G. E. Edaño & H. Gutierrez* 38570 (K), *G.L. Alcasid* 1708 (L), *Haenke* s.n. (BM (photo), K (photo)), *H.N. Whitford* 966 (K), *J. Sinclair & E. Edaño* 9611 (K), *M.G. Price* 654 (BM, K, L), *M. G. Price* 737, 919, 941, 2734 (K), *M. Ramos* 22090 (BM), *Sands* 3056 (K); **Mindoro**, *A.C. Podzorski* 528 (L), *C.E. Ridsdale, M.J.E. Coode & E. Reynoso* 5322 (K, L), *E.D. Merrill* 1773, 4042 (K), *M. Celestino & A. Castro* 2015 (L), *M.G. Price* 654, 737 (BM), *M. G. Price* 694 (BM, K, L), *M. Ramos* 39434 (L); **Samar**, *G.E. Edaño* PNH 15137 (BM), *M.D. Sulit* PNH 13952 (BM); **Leyte**, *G.E. Edaño* PNH 11205 (BM); **Panay**, *Cuming* 356 (BM), *G. Edaño* 30830 (BM); **Palawan**, *E.D. Merrill* 9315 (BM, L), *M.D. Sulit* PNH 12644 (BM); **Negros**, *A.D.E. Elmer* 9853 (BM, K, L), *M.G. Price* 2503 (K); **Siargao Islands**, *M. Ramos, J. Pascasio* 34965 (K); **Mindanao**, *A.D.E. Elmer* 10792 (BM, K, L), *A.D.E. Elmer* 13957 (K, L), *C.M. Weber* 1488 (BM, K), *Copeland* 951 (K (photo), MICH), *D.R. Mendoza* 42465 (L), *D. Mendoza & P. Convocar* PNH 8603 (BM), *M. Ramos* 1140 (BM), *R.S. Williams* 2225 (PE); **Moluccas**, *B.S. Parris* 11149 (K, L), *K. Iwatsuki, M. Kato, K. Ueda & U.W. Mahjar* C-850 (K, L), *Larn* 3600 (L), *M. Kato, B. Sunarno and H. Akiyama* C-4132 (L), *M. Kato, K. Ueda and Z. Fanani* C-11681, C-12028, C-13323, C-13748, C-

14183 (L), *Russen* 1804 (L); **New Guinea**, *C. Boden Kloss* s.n. (K), *Johns* 7755 (L), *L. Bamlor* 190 (L), *M.J.S. Sands* 6297 (K, L); **PAPUA NEW GUINEA**: *A.C. Jermy* 4529 (BM), *A. Kairo* 106 (K, L), *A. Millar & Holttum* NGF. 15867 (K), *Bamler* 111 (K), *B.S. Parris, J.P. Croxall* 8292 (K), *C.E. Carr* 14929 (K, L), *G. Larivita & P. Katik* LAE 67166 (BM, L), *H. Lahn* s.n. (L), *H. Streimann & P. Katik* NGF 28657 (K, L), *H. Streimann* NGF 44578 (K, L), *H. Streimann & Y. Lelean* LAE 52734 (K, L), *J.R. Croft* 1113 (L), *J.R. Croft* 1636 (K, L), *J. Croft et al.* LAE 61579 (L), *J.R. Croft* LAE 71418 (K), *K. Rau* 385 (L), *L. J. Brass* 13855A, 27123 (L), *L. J. Brass* 23590 (BM, L), *P. van Royen* 4240 (L), *P. van Royen & H. Sleumer* 6549 (K, L), *R. Pullen* 8366 (L), *Sir W. M. Gregor* 117 (K), *T.G. Walker* T. 8987, T. 8992 (BM), *Trevor G. Walker* T. 9120-1 (BM, L), *W. Takeuchi* 6047, 7362, 9033, 10997 (L), *W. Takeuchi & D. Ama* 15592 (L); **BISMARCK ARCHIPELAGO**: **Admiralty Island**, *J.R. Croft* 1113 (K), **New Britain**, *J.R. Croft & P. Katik* NGF 41279, NGF 41493 (K), *P.F. Stevens & Y. Lelean* LAE 58685 (K, L), **New Ireland**, *A.C. Jermy* 7963 (BM, L), *Dissing, Kjøie & S. Olsen* 1956 (K), *J.R. Croft* 250 (K), *J.R. Croft* 1944 (K, L), *J.R. Croft* LAE 68289 (K, L), **Misima Island**, *J.R. Croft* LAE 71418 (L); **SOLOMON ISLANDS**: *A. Nakisi & D. Babala* BSIP 8227 (L), *C.W. Chen, T.C. Hsu* SITW00179, SITW00313 (TAIF), *C.W. Chen, T.Y.A. Yang, T.C. Hsu, M. Fanerii* SITW01077 (TAIF), *J.H.L. Waterson* s.n. (K), *Milne* 581 (K), *Royal Society Exped.* 4350 (K), *T.C. Whitmore, P. J. Grubb* BSIP 2108 (K, L); **VANUATU**: **New Hebrides**, *Macgillivrey* s.n. (K); **FIJI**: *A.C. Smith* 1012, 5604, 8676, 9034 (K), *A.C. Smith* 5107, 7205, 7359 (K, L), *B.E. Parham* HS 39 (K), *Buchanan* s.n. (K), *Cairns* s.n. (K), *H.E. Parks* 20256 (K), *J.D. Tothili* 927 (K), *J.H. Vaughan* 3273 (K), *Milne* 520 (K), *O. Degener* 14350, 15282 (K), *Seemann* 748 (K), *Walker* 219, s.n. (K); **SAMOA**: *D.W. Garber* 735 (K), *F. Vaupel* 63 (K, L, PE), *H. Kennedy & W. Teraoka* 3978 (K), *P.A. Cox* 223 (K), *W.A. Sledge* 1524 (K), *Whitmee* 1016 (K); **COOK ISLANDS**: *W.R. Philipson* 10427 (L); **SOCIETY ISLANDS**: *J.E. Tilden* 485, 585 (K), *Pancher* s.n. (K), *T.F. Cheeseman* 775 (K); **Tahiti**, *E.B. Copeland* 3986 (K).

- 10. *Tectaria devexa*** (Kunze) Copel., *Philipp. J. Sci.*, C 2: 415. 1907; Ching, *Sinensia* 2(2): 16. 1931; Kjellb. & C. Chr., *Bot. Jahrb. Syst.*: 49. 1934; Backer & Posth., *Varenfl. Java*: 72. 1939; Tardieu & C. Chr., *Fl. Indo-Chine* 7(2): 404. 1941; Copel., *Philipp. J. Sci.* 77(4): 414. 1949; Holttum, *Rev. Fl. Malaya* ed. 1, 2: 505, f. 297. 1955 [‘1954’]; Ching, *Acta Phytotax. Sin.* 8: 150. 1959; Holttum, *Dansk Bot. Ark.* 23: 242. 1965; Holttum & Roy, *Blumea* 13: 135. 1965; Sledge, *Kew Bull.* 27: 416. 1972; C.E. DeVol & C.M. Kuo, *Fl. Taiwan* 1: 342. 1975; S.C. Chin, *Gard. Bull. Singapore* 30: 190. 1977; C.M. Kuo, *Taiwania* 30. 28. 1985; Holttum, *Gard. Bull. Singapore* 34: 136. 1981; Sledge, *Bot. J. Linn. Soc.* 84: 18. 1982; Holttum, *Indian Fern J.* 1: 36. 1985; Tagawa & K. Iwats., *Fl. Thailand* 3(3): 366. 1988; Holttum, *Kew Bull.* 43(3): 485. 1988; *Fl. Males.*, Ser. 2, Pterid. 2: 57, f. 11b, f. 1991; J.L. Tsai & W.C. Shieh, *Fl. Taiwan*, ed. 2: 297, pl. 126. 1994; I.M. Turner, *Gard. Bull. Singapore* 47(1): 54. 1995; Bostock, *Fl. Australia* 48: online, f. 133G. 1998; Boonkerd & Pollawatn, *Pterid. Thailand*: 212. 2000; S. Linds., D.J. Middleton, Boonkerd & Suddee, *Thai For. Bull.*, Bot. 37: 98. 2009; F.W. Xing, Y.H. Yan, S.Y. Dong, F.G. Wang, Christenh. & Hovenkamp., *Fl. China* 2-3: 735. 2013. Type: Java,



- Zollinger* 2717 [lectotype (designated here) B! (B 20 0030298), isolectotype BM!, photo BM!, K! (K000237040), P! (photo seen P01512523)].
- Aspidium devexum* Kunze, Bot. Zeit. 6: 259. 1848, *nom. nud.* Type: as for above.
- Aspidium intermedium* J. Sm. ex Mett., Abh. Senckenberg. Naturf. Ges. 4: 119. 1857 (non Muhl. ex Willd., 1810), *nom. illeg. hom.* Type: as for *A. devexum*.
- Aspidium devexum* Kunze ex Mett., Ann. Mus. Bot. Lugd.-Bat. 1: 237. 1864, *nom. illeg. hom.* Type: as for *A. devexum*.
- Ctenitopsis devexa* (Kunze) Ching & Chu H. Wang, Acta Phytotax. Sin. 9(4): 369. 1964; S. G. Lu & T.Y.A. Yang, Taiwania 50(2): 158. 2005. Type: as for *A. devexum*.
- Pleocnemia devexa* (Kunze) Alderw., Malayan Ferns: 174. 1908. Type: as for *A. devexum*.
- Polypodium membranaceum* Hook., Five Months on the Yangtze, Appendix: 365–366. 1862, *nom. illeg. hom.* — Type: China, Sichuan, *Blakiston* s.n. [holotype K! (K001080740)].
- Aspidium membranaceum* Hook., Sp. Fil. 5: 105. 1864. Type: Philippines, *Cuming* 277 [lectotype K! (K000360410), isolectotype K! (K000360411)].
- Pleocnemia membranacea* (Hook.) Bedd., Suppl. Ferns Brit. Ind.: 15, pl. 243. 1876; Handb. Ferns Brit. India: 225. 1883. — Type: as for *A. membranaceum*.
- Aspidium giganteum* Blume var. *minor* Hook., Sp. Fil. 4: 50. 1862. Type: Sri Lanka, *Thwaites* CP 1358 [holotype K! (K001080701), isotypes B! (B 20 0168049, B 20 0168051, B 20 0168052, B 20 0168053), BM! (BM000527564, BM000527765, BM000527767, BM000527768, BM000543763), K! (K001080702), L! (photo seen L 0052160), P! (photo seen P01361268, P01361269, P01545678)].
- Sagenia gigantea* (Blume) T. Moore var. *minor* Bedd., Ferns S. India: pl. 243. 1863–1865 [1863]. Type: as for *A. giganteum* var. *minor*.
- Tectaria devexa* (Kunze) Copel. var. *minor* (Hook.) Holttum, Kew Bull. 43(3): 486. 1988; Blumea 35: 550. 1991; Fl. Males., Ser. 2, Pterid. 2: 57. 1991. Type: as for *A. giganteum* var. *minor*.
- Pleocnemia devexa* (Kunze) Alderw. var. *permutatum* Alderw., Bull. Jard. Bot. Buitenzorg 23: 18. 1916. Type: Java, Buitenzorg, Tjampea, *C.A. Backer* 21015 [holotype L! (L 3612795)].
- Tectaria devexa* (Kunze) Copel. var. *novoguineensis* Holttum, Blumea 35: 550. 1991; Fl. Males., Ser. 2, Pterid. 2: 58. 1991. — Type: cult. Kew, Papua New Guinea, *Holttum* 31 [holotype K! (K000362461)].

*Rhizome* short, erect, densely scaly at apex; *scales* basifixed, concolorous, castaneous to dark brown, 4–7 × 1–1.5 mm, linear-lanceolate, apex acuminate, margin entire. *Fronde* monomorphic, lamina bipinnatifid to tripinnatifid at base, bipinnatifid to bipinnate upwards; stipes dark brown to dull castaneous, grooved, 16.0–23.0 cm long, covered with short hairs throughout, scaly at base; lamina ovate-subdeltoide, 20.0–35.0 × 20.0–30.0 cm; basal pinnae 13.0–15.0 × 8.0–11.0 cm, stalked, stalk 1.0–1.5 cm long, ovate-lanceolate, deeply lobed; basal pinnule 5.0–10.0 × 2.0–3.0 cm, shortly stalked at lower pinnules and sessile upward, stalk 0.1–0.3 cm long, lanceolate-oblong, sometimes falcate, apex acuminate, base cordate, margin deeply lobed to 4/5 towards costules, lobes lanceolate-oblong, apex acute, margin crenate to lobed; apical pinnule 2.5–4.5 × 1.5–2.0 cm, lanceolate, apex acute to acuminate, base

round to subtruncate, margin lobed to 4/5 towards costules, lobes lanceolate, apex acute, margin crenate to lobed; terminal pinnule 10.0–12.0 × 7.0–8.0 cm, ovate-subtriangular, asymmetric, apex acuminate, base asymmetrically cuneate, margin deeply lobed to 4/5 towards costule, lobes lanceolate, apex acute, margin crenate to lobed; lateral pinnae 3–4 pairs, alternate to subopposite, stalked at lower pinnae and subsessile upwards, stalks 0.3–0.5 cm long, 5.0–10.0 × 2.0–4.5 cm, lanceolate-falcate, apex acuminate, base asymmetrically round, margin lobed to 4/5 towards costae or costules, lobes lanceolate, apex acute, margin crenate to lobed, secondary pinnules usually present, 2.0–3.0 × 0.5–1.0 cm, lanceolate, apex acuminate, base cordate or fused with costule, margin deeply lobed to 2/3 towards costule, lobes lanceolate, apex acute to obtuse, margin crenate to lobed, interval 2.0–4.0 cm; terminal pinna 10.0–15.5 × 6.5–11.0 cm, ovate-lanceolate, apex acute, base cuneate, margin deeply lobed to 4/5 towards costa, lobe lanceolate-falcate, apex acute to acuminate, margin subentire to irregularly crenate; papyraceous, pubescent on both surface, covering with short white hairs throughout, densely hairy on costae, costules and midrib, veins partly anastomosing forming costal and costular areoles without free included veinlets, otherwise free, forked. *Sori* round, terminal on free veins, arranged in two rows between main veins; indusia round-reniform, thin, peltate, persistent. **Fig. 4.10.**

Thailand.— NORTHERN: Chiang Mai, Chiang Rai (Tham Luang-Khun Nam Nang Non Forest Park), Nan (Tham Sako National Park); NORTH-EASTERN: Phetchabun (Sap Chomphu Arboretum), Loei (Nong Hin); EASTERN: Chaiyaphum (Nam Phrom, Phu Khiao Wildlife Sanctuary), Nakhon Ratchasima (Pak Chong); CENTRAL: Saraburi (Muak Lek); SOUTH-WESTERN: Kanchanaburi (Sai Yok), Prachuap Khiri Khan (Khao Sam Roi Yot National Park); PENINSULAR: Chumphon (Khao Wiang, Pathio), Ranong (La-un), Surat Thani (Khlong Phanom National Park), Nakhon Si Thammarat [Khanom, Khao Luang National Park, Khao Nan National Park, Lansaka (Wang Si Thammasokarat Cave), Nopphitam], Songkhla (Saba Yoi).

Distribution.— Sri Lanka, China (Sichuan, Yunnan, Chongqing, Guizhou, Guangxi, Hainan, Guangdong, Taiwan), Japan (Honshu, Kyushu, Ryukyu Islands), Vietnam, Malesia (Peninsular Malaysia, Sumatra, Java, Timor, Borneo, Sulawesi), Philippines (Luzon, Mindoro, Palawan, Samar, Bohol, Mindanao), Moluccas, New Guinea, Papua New Guinea, Australia (Christmas Island, Queensland), Vanuatu (New Hebrides).

Ecology.— Growing on cliffs or rocks crevices in shady places in evergreen forest, usually on limestone bedrock or rarely on sandstone bedrock, or terrestrial on calcareous soil in shady places in evergreen forest at 20–600 m alt.

Specimens examined.— **THAILAND:** Chumphon, Khao Wiang, c 200 m, 11 Jan. 1927, *A.F.G. Kerr* 11367 (BK, BM, K); Saraburi, Muak Lek, 200 m, 29 Apr. 1922, *A. Marcan* 805 (BM); Chaiyaphum, Nam Phrom, 600 m, 10 Dec. 1971, *C.F. van Beusekom, C. Phengklai, R. Geesink, B. Wongwan* 4090 (BKF, L); Chaiyaphum, Nam Phrom, 16° 20' N 101° 45' E, 600 m, 12 Oct. 1971, *C.F. van Beusekom, C. Phengklai, R. Geesink, B. Wongwan* 4187 (BKF, L); Ranong, La-un, Ban Nai Wong, 10.031 N 98.841 E, 300 m, 19 Feb. 2006, *D.J. Middleton, C. Hemrat, S. Lindsay, S. Suddee & S. Suwanachat* 3810 (BKF, E, L); Surat Thani, Phanom, Khlong Phanom National Park, Trail from headquarters around base of limestone mountain, 8° 53' N 98° 41' E, c 100 m, 11 Apr. 2003, *D.J. Middleton, S. Lindsay & R. Pooma* 2130 (BKF); Saraburi, Muak Lek, 200 m, 29 Apr. 1922, *E. Smith* 467 (K); Nakhon

Ratchasima, Pak Chong, 31 Dec. 1924, *E. Smith* 2175 (K); Chumphon, Pathio, Khao Teen Pet, 50 m, 16 Jan. 1987, *J.F. Maxwell* 87-55 (BKF, CMU, L, PSU); Songkhla, Saba Yoi, Tham Ru Nok Sak, 100 m, 21 Oct. 1991, *K. Larsen, S.S. Larsen, C. Niyomdham, W. Ueachirakan & P. Sirirugsa* 42478 (BKF); Chaiyaphum, Phu Khiao Wildlife Sanctuary, 16° 25' N 102° 05' E, 600–700 m, 3 Aug. 1972, *K. Larsen, Supee S. Larsen, I. Nielsen & T. Santisuk* 31318 (BKF); Kanchanaburi, Sai Yok, Huai Mae Nam Noi, 250 m, 2 Jan. 1962, *K. Larsen* 9097 (K); Nakhon Si Thammarat, Nopphitum, Tham Lot, 8° 47.17' N 99° 38.38' E, 80 m, 13 Feb. 2005, *K. Williams, R. Pooma, M. Poopath, V. Chumchamroon* 1466 (BKF); Chiang Rai, Mae Sai, Tham Luang-Khun Nam Nang Non Forest Park, Tham Phaya Nok, 500 m, 3 Nov. 2010, *M. Norsaengsri & N. Tathana* 7280 (QBG); Chumphon, Thap Li, 8 Sep. 1927, *Put* 1012 (BK, BM, K); Prachuap Khiri Khan, Khao Sam Roi Yot National Park, Tham Phrayanakorn, 2 Oct. 2012, *R. Pollawatn & A. Petchbanna* 2012-252 (BCU); Loei, Nong Hin, 422 m, 19 Jan. 2011, *T. Boonkerd et al.* 2011-9 (BCU); Loei, Nong Hin, Suan Sawan, 580 m, 20 Jan. 2011, *T. Boonkerd et al.* 2011-13 (BCU); *ibid.*, 560 m, 17 Mar. 2011, *T. Boonkerd et al.* 2011-72 (BCU); Loei, Nong Hin, 650 m, 18 Mar. 2011, *T. Boonkerd et al.* 2011-88 (BCU); Loei, Nong Hin, Piang Din Waterfalls, 636 m, 28 May 2011, *T. Boonkerd et al.* 2011-245 (BCU); Loei, Nong Hin, Tham Orathai, 670 m, 15 Jul. 2011, *T. Boonkerd et al.* 2011-284 (BCU); Nakhon Si Thammarat, Khanom, Kuab Thong, Tham Khao Wang Thong, 42 m, 19 Oct. 2011, *T. Boonkerd et al.* 2011-421 (BCU); Nakhon Si Thammarat, Khanom, Tham Khao Krod, 20–30 m, 19 Oct. 2011, *T. Boonkerd et al.* 2011-429 (BCU); Loei, Nong Hin, 10 Nov. 2011, *T. Boonkerd et al.* 2011-480 (BCU); Nakhon Si Thammarat, Lan Saka, Tham Nam Wang Si Thammasokarat, 29 Mar. 2013, *T. Boonkerd et al.* 2011-719 (BCU); Phetchabun, Nong Phai, Sap Chomphu Arboretum, 30 Aug. 2013, *T. Boonkerd et al.* 2011-761 (BCU); Nakhon Si Thammarat, Khao Nan National Park, Tham Luang, 270 m, 26 Jan. 2007, *T. Boonkerd, S. Chantanaorrapint & W. Khwaiphphan* 410 (BCU); Prachuap Khiri Khan, Pran Buri, Khao Sam Roi Yod National Park, Khao Tien, 0–140 m, 5 Dec. 1979, *T. Shimizu, H. Toyokuni, H. Koyama, T. Yahara & C. Niyomdham* T-26134 (L); Nan, Song Khwae, Tham Sako National Park, Tham Luang, 13 May 2011, *W. La-ongsri, P. Tatiya and S. Satatha* 1714 (QBG);

**SRI LANKA:** *Beddome* s.n. (BM, K), *C.B. Clarke* 10373 (K), *C.W. Hope* 43/55 (P), *D.C.G. Raniall, Hb. Rawson* s.n. (BM), *G. Wall* 43155 (BM), *J.S. Gamble* 27548 (K), *J. Smith* s.n. (BM), *R.B. & A.J. Faden* 77/38 (K), *Thwaites* CP 1358 (B, BM, K, L, P), *Wall* s.n. (P); **CHINA:** **Sichuan,** *Blakiston* s.n. (K); **Yunnan,** *A. Henry* 11530 (K), *A. Henry* 13241 (K, P), *H.T. Tsai* 61060 (P), *J. Cavalerie* 1887, 7184 (K), *W. Hancock* 167 (K); **Guizhou,** *J. Cavalerie* 2052 (BM, K), *Y. Tsiang* 7321 (BM); **Guangxi,** *A. Henry* 18 (K), *Beijing Youth Team* 0807 (TAIF), *P.J. Cribb, K.C. Chau, Y.B. Luo, H.N. Qin, L.P. Siu, Y.G. Wei* ASBK 198 (K); **Hainan,** *S.K. Lau* 2976 (P); **Guangdong,** *C.G. Matthew* s.n. (K), *T. Sampson* 7815 (B, K); **Taiwan,** *A. Henry* 1934 (K), *B.J. Wang* 1028 (TAIF), *B.J. Wang* 2746, 2990 (TAI), *C.C. Chuang, J.M. Chao & M.T. Kao* 3429 (L, TAI), *C.E.D.* 8314 (TAI), *C.E. DeVol* 8175 (PH, TAI), *C.C. Hsu* 529 (TAIF), *C. Henry* s.n. (P), *C.H. Yu* 1009, 1156 (TAI), *C.L. Pan* 182 (TAIF), *C.M. Kao, C.T. Shih, C.M. Chen, Y.L. Lin, M.C. Tsai* 148 (TAIF), *C.M. Kuo* 689, 944, 1861, 1925, 2126, 15545 (TAI), *C.M. Kuo, H.T. Yu* 13933 (K), *C.S. Kuoh* 4005, 4034, 4169, 4317 (TAI), *C.W. Chen* Wade2468 (TAIF), *E. Matsuda* s.n. (TAI), *E. Zogg* 1986 (L), *Farrer* 10914 (K), *F.W. Li* FWL853 (TAIF), *G. Masamune* s.n.

(TAI), *H.C. Hung* 482 (TAIF), *H. H. Chang* 2088 (TAI), *H.L. Chiang* 3031, 3044, 3046, 3469 (TAIF), *H. Ohashi, Y. Tateishi, J. Murata, Y. Endo, T. Nemoto & Y. Ueno* 14742 (TAI), *I. Simozawa* 198 (TAI), *J.Y. Hwang & C.Y. Hwang* 31 (TAI), *K.U. Kramer, E. Zogg & H. Gassner* 7952, 8097 (L), *Kuo et Yu* 13933 (TAI), *K.C. Yang, S.J. Moore et al.* s.n. (TAIF), *L.Y. Chou* 3 (TAI), *M.L. Weng* 1026, 1042, 1230, 2025 (TAI), *Maries* s.n. (K), *M.F. Kao* 2203, 2903, 2938 (TAI), *M. Tagawa* 1391, 2437 (BM, K), *M.T. Kao* 6816, 7263 (PH, TAI), *M.T. Kao* 7100, 7145 (TAI), *O. Warburg* s.n. (P), *P.H. Lee* 371, 3122 (TAIF), *P.H. Lee, L.S. Kuo* 3217, 3229 (TAIF), *P.H. Lee, S.W. Chung* 2910 (TAIF), *P.F. Lu* 379, 522, 1521, 1522, 1739, 1965, 1969, 1970, 2086, 2099, 3298, 3541, 3652, 6495, 7283, 7623, 8957, 9144, 10346, 10619, 11137, 11225, 12850, 13335, 13895, 15266, 19397, 20481, 20916, 21118, 21372, 21694, s.n. (TAIF), *R. Moran* 5457 (BM, TAIF), *R.T. Li* 2854 (TAI), *S.F. Huang* 605 (TAI), *S.F. Huang, S.Y. Yang* 4951 (TAI), *S.J. Yang* 28682 (TAIF), *S.W. Chung* 6413 (TAIF), *S.W. Chung, P.H. Lee & H.H. Kuo* 6104, 6134 (L), *S.L. Gu, L.W. Chang, S.H. Lin, S.H. Wu* 42 (TAIF), *S. Sasaki* s.n. (TAI), *S. Suzuki* 5717 (TAI), *S. Suzuki* 10619 (PH), *Suzuki-Tokio* 4947, 6114 (TAI), *T.C. Huang* 8813, 8815, 8837, 9042 (TAI), *T. Hosokawa* 1575, 1576, 1577, 1578 (TAI), *T. Ito* s.n. (TAIF), *T. Kawakami, U. Mori* 3432 (TAIF), *T. Murakami, Y. Saiki et C.M. Chen* 104 (BM, L), *T.Y. Chiang* 22612 (TAI), *T.Y. Yang* 203, 215 (TAI), *U. Faurie* 69 (L), *U. Faurie* 8226 (TAI), *U. Paup* 31 (P), *W.R. Piece* 686 (K), *W.P. Leu* 1610 (BM), *Y.F. Chen* 9210 (TAI), *Y.H. Chang* 20080709-012, 20081125-029, 20081125-030, 20131203-014 (TAIF), *Y.H. Tzeng* 817, 864 (TAIF), *Y.J. Lai, H.Y. Chen, C.H. Yu* 967 (TAI), *Y. Kudo et S. Suzuki* 15857 (TAI), *Y.M. Huang* 1197, 1198 (TAIF), *Y. Tateishi, J. Murata, Y. Endo, T. Nemoto & Y. Ueno* 15455, 16280 (TAI), *Y. Yamamoto* 66 (TAI); **JAPAN: Honshu, Yokohama, L. Boehmer & Co.** 13 (B); **Kyushu, Ferrie** s.n. (K); **Ryukyu Islands, Alf. Unger's Sammler** 1904 (B), *G. Koidzumi* s.n. (BM, L, P), *K. Yasuda* 1550 (K), *M. Furuse* 3100, 5450 (K), *M. Tagawa & K. Iwatsuki* 2132, 2252, 4925 (P), *M. Tagawa & K. Iwatsuki* 2209 (BM, K); **VIETNAM: A. Chevalier** 29715 (K, P), *A. Chevalier* 29747 (BM, K, L, P), *A. Petelot* 432 (BM, P), *A. Petelot* 460, 541 (P), *B. Balansa* 21, 51 (K), *B. Balansa* 85 (K, P), *B. Balansa* 90 (P), *Colani* 2708, 2742, 2743, 3390, s.n. (P), *Colani* 3392 (BM, P), *D' Simond* s.n. (P), *Eberhardt* 5219 (P), *H. van der Werff, N.K. Dao, B. Gray & D.T. Doan* 17485 (PE), *J. Esquirol* 2253 (BM), *J. Millet* s.n. (P), *L. Cadiere* 17, 19 (P), *M. d'Alleizette* 468 (P), *M. l'abbé Bon* s.n. (P), *N.T. Hiep, P.K. Loc, L. Averyanov* NTH 3764 (K), *O. Debeaux* 294 (P), *R.P. Bon* s.n. (P), *Vieillard* 432 (K); **MALESIA: Peninsular Malaysia, B.S. Parris, J.F. Croxall** 10451 (K), *B.S. Parris, P.J. Edwards* 10451 (L), *C. Curtis* 3375 (K), *C.G. Matthew* s.n. (K), *Dr. King's collector* 2191 (K), *F.S.P. Ng* FRI 5540 (L), *H.N. Ridley* 8136, 8643 (K), *Hose* s.n. (K), *J. Sinclair* 40052 (BM, K, L), *K. Imin* FRI 63203, FRI 66409 (K), *M. Nur* 12088 (K), *R. Kiew* RK 1386 (K), *Scortechini* s.n. (K), *T. Shimizu & B.C. Stone* 13730, 14383 (L), *T. Shimizu & N. Fukuoka* M-14123 (L), *UNESCO Limestone Expedition* 253 (K), *UNESCO Limestone Expedition* 260 (K, L), *W. Meijer* 5801 (L); **Java, C.A. Backer** 21015 (BM (photo), P (photo)), *Danser* 6377 (L), *D. Vriese* 299 (K, L), *Luerssen* 2766 (P), *Zollinger* 2717 (B, BM (specimen & photo)); **Timor, C.W. Kooy** 279 (L); **Sumatra, R.E. Holtum** SFN 28121 (K); **Borneo, A.C. Jermy** 14477 (BM, L), *B.S. Parris* 7056 (K), *BCS-EFA-LM et al.* SAN 86731 (L), *C. Hansen* 312 (K), *C. Hose* 197 (BM, K), *C.J. Brooks* s.n. (BM), *C.S. Backer* 21025 (L), *Dr. E. Mjoberg* s.n. (BM), *House* s.n. (P), *J. & M. S.* 20731 (BM, K, L), *J.A.R. Anderson* S

20835, S 31685, S. 31813 (K, L), *J.A.R. Anderson & H. Keng* K 64 (K, L), *K.K. Tiong* SAN 87957 (K, L), *M. Hotta* 15310 (L), *M. Kato & H. Wiriadinata* B-5489 (K, L), *M. Kato, M. Okamoto & K. Ueda* B-11714 (K, L), *Mohidin* S 21631 (K, L), *Native collector* 1526 (L, P), *P. H. Hovenkamp* 05-312 (L), *P.S. Ashton* A 335 (K), *P.S. Shim* SAN 134244 (L), *Rantai et al.* S 66032 (K), *T.G. Walker* T13112, T13338, T13342, T14187 (BM), *T.G. Walker* T13117 (L), *T.G. Walker* T13118 (K), *W. Meijer* SAN 37946 (K), *Y.P. Ching* S40180 (L); **Sulawesi**, *C.J. Brooks* 16859 (BM), *E.F. de Vogel* 5742 (L), *E. Hennipman* 5720 (K, L), *L. Joncheere* 1372 (L), *L. Joncheere* 1715 (BM, K, L), *S. Soenarko* 253 (K); **Moluccas**, *M. Kato, K. Ueda and Z. Fanani* C-11252 (L), *M. Kato, K. Ueda, M. Okamoto, B. Sunarno & U.W. Mahjar* C-5978, C-6213, C-8009 (K, L); **Philippines**: *Cuming* 277 (K), *Cuming* s.n. (B); **Luzon**, *Cuming* s.n. (L), *M. G. Price* 274, 2260, 3000 (K); **Mindoro**, *M.D. Sulit & H.C. Conklin* PNH 16685 (K); **Palawan**, *J. Dransfield* SMHI 1206 (K), *J. Dransfield* SMHI F13 (L); **Samar**, *Jagor* 1001 (B), *University of San Carlos* 399 (L); **Bohol**, *M. Ramos* 43051 (B, BM, P); **Mindanao**, *E.B. Copeland* 898 (K); **New Guinea**, *A. Eddy* s.n. (BM), *C. Bamler* 63 (P), *W. Ave* 4210 (L); **PAPUA NEW GUINEA**: *Holtum* 31 (K), *J.R. Croft & J.I. Marsh* 837 (L), *K. Rau* RAU 464 (L), *L.J. Brass* 32188 (K, L), *Millar & Holtum* 18638 (K, L); **AUSTRALIA**: **Christmas Island**, *C.B. Kloss* s.n. (BM, K), *C.W. Andrews* 12 (BM), *C.W. Andrews* 12131 (K), *D.J. & B.P. Du Puy* CI 17 (K), *H.N. Ridley* 186bis (K), *J.J. Lister* s.n. (K); **VANUATU**: **New Hebrides**: *A.F. Braithwaite* RSNH 2084 (K), *A. F. Braithwaite* RSNH 2542 (K, L), *P. Veitch* 159 (K).

**11. *Tectaria fauriei*** Tagawa, *J. Jap. Bot.* 14: 102. 1938; *Acta Phytotax. Geobot.* 10: 203. 1941; *J. Jap. Bot.* 36(6): 208. 1961; Tagawa & K. Iwats., *S. E. Asian Stud.* 5: 98. 1967; C.E. DeVol & C.M. Kuo, *Fl. Taiwan* 1: 342. 1975; Nakaike, *Enum. Pterid. Fil.* : 263. 1975; E.H. Walker, *Fl. Okinawa*: 86. 1976; Holtum, *Gard. Bull. Singapore* 34: 146. 1981; C.M. Kuo, *Taiwania* 30: 29. 1985; Tagawa & K. Iwats., *Fl. Thailand* 3(3): 381, f. 35. 6–7. 1988; Holtum, *Fl. Males.*, Ser. 2, *Pterid.* 2: 67. 1991; J.L. Tsai & W.C. Shieh, *Fl. Taiwan*, ed. 2: 297. 1994; I.M. Turner, *Gard. Bull. Singapore* 47(1): 54. 1995; Boonkerd & Pollawatn, *Pterid. Thailand*: 212. 2000; S.K. Wu, *Acta Phytotax. Sin.* 40(6): 532. 2002; S.G. Lu & T.Y.A. Yang, *Taiwania* 50(2): 158. 2005; S. Linds., D.J. Middleton, Boonkerd & Suddee, *Thai For. Bull., Bot.* 37: 98. 2009; Fraser-Jenk., *Bull. Natl. Mus. Nat. Sci.*, Ser. B 38(4). 176. 2012; F.W. Xing, Y.H. Yan, S.Y. Dong, F.G. Wang, Christenh. & Hovenkamp, *Fl. China* 2-3: 737. 2013. Type: China, Taiwan, *U. Faurie* 67 [holotype KYO, isotype MICH! (photo seen MICH1191044)].

*Tectaria fengii* Ching & Chu H. Wang, *Acta Phytotax. Sin.* 19(1): 127. 1981. Type: China, Yunnan, *K.M. Feng* 20725 [holotype PE! (photo seen PE00044736), isotype PE! (photo seen PE00044836), photo K!].

*Tectaria gemmifera* Ching & Chu H. Wang, *Acta Phytotax. Sin.* 19(1): 127. 1981, *nom. illeg. hom.* Type: China, Yunnan, *C.W. Wang* 80044 [holotype PE! (photo seen PE00044738), isotypes A! (photo seen A00021894), PE! (photo seen PE00044737, PE00044739)].

*Tectaria simulans* Ching & Chu H. Wang, *Acta Phytotax. Sin.* 19(1): 129–130. 1981. Type: China, Yunnan, *W.C. Wang* 10347 [holotype PE! (photo seen PE00044753), photo K!].

*Tectaria hainanensis* Ching & Chu H. Wang, Acta Phytotax. Sin. 9(4): 371. 1964.

Type: China, Hainan, *F.C. How* 72939 [holotype PE! (photo seen PE00044743), isotypes GH! (photo seen GH00021895), PE! (photo seen PE00044742), UC! (photo seen UC 996043)].

*Rhizome* short, erect, scaly; *scales* basifixed, bicolored, castaneous to dark brown with narrowly paler margin, 5–8 × 1–2 mm, lanceolate, apex acuminate, margin minutely toothed. *Fronde*s monomorphic, lamina pinnatifid, rarely simple, entire; stipe and rachis stramineous to dull brown, grooved, 12.0–85.0 cm long, winged in upper half or narrowly nearly to the base, wing 0.3–0.6 cm wide on stipe and 0.3–2.0 cm wide on rachis, becoming narrower towards base, scaly at base; lamina 22.5–55.0 × 15.0–28.0 cm, ovate-elliptic in outline, rachis winged throughout; basal pinnae 15.0–28.0 × 7.0–12.0 cm, opposite, asymmetric, elliptic-oblongate, apex acuminate, margin entire to slightly irregularly crenate, more or less having basal basiscopic lobe the longest, basal basiscopic lobe 3.0–15.0 × 1.5–3.0 cm, elliptic, apex acuminate, margin entire; lateral 1–2 pairs or none, 15.0–28.0 × 7.0–12.0 cm, opposite, asymmetric, oblongate-broadly lanceolate, apex acuminate, base acute, margin entire, proliferous bulbils on rachis sometimes present; terminal pinnae 22.0–35.0 × 7.0–12.0 cm, elliptic-broadly lanceolate, apex acuminate, base cuneate to attenuate, margin entire or slightly crenate; texture chartaceous, glabrous on both surfaces except few short hairs on midrib or main veins beneath, venation anastomosing to form many areoles and areolules with free included veinlets, veinlets simple or forked, costal areoles more or less having free included veinlets. *Sori* round, terminal on included free veinlets or dorsal on anastomosing veins, arranged in 2 rows between adjacent cross veins and 2–5 irregular rows between main veins; indusia small, round-reniform, caducous. **Fig. 4.11.**

Thailand.— NORTHERN: Mae Hong Son [Mae Sariang (Tin Tok)], Chiang Mai (Chiang Dao Wildlife Sanctuary), Chiang Rai (Doi Tung, Lam Nam Kok National Park, Mae Chan, Mae Sai, Namtok Khun Khon Forest Park), Nan (Doi Phu Kha National Park, Tham Sakoen National Park, Tha Wang Pha), Lampang, Phitsanulok (Thung Salaeng Luang National Park); EASTERN: Chaiyaphum (Phu Khiao Wildlife Sanctuary); PENINSULAR: Narathiwat.

Distribution.— India (Assam), Myanmar (N Shan States), China [Yunnan, Hainan, Taiwan (Type)], Japan (Ryukyu Islands), Vietnam, Malesia [Peninsular Malaysia (Pahang)].

Ecology.— Terrestrial in shady places along stream in evergreen or deciduous forest at 200–1,300 m alt.

Vernacular.— Goot (กูด); Biam hong miah (เบี่ยมหงมีฮะ) (Yao).

Uses.— Medicinal plant of Yao tribe for curing skin disease by soaking leaves in water, then roasting and rubbing on skin (Fahmdin, interviewed, 13 February 1991).

Note.— This species is similar to *Tectaria vasta* (Blume) Copel. but differing in its unequal and smaller wing at stipe and rachis and often bearing proliferous bulbils on rachis.

Specimens examined.— **THAILAND:** Chaiyaphum, Phu Khiao Wildlife Sanctuary, *A. Sathapattayanon* 732 (BCU); *ibid.*, *A. Sathapattayanon* 831 (BCU); Chiang Mai, Chiang Dao, Chiang Dao Wildlife Sanctuary, 570 m, 19 Dec. 1996, *David Allen P* 31 (CMUB, L); Nan, Tha Wang Pha, Pha Thong, Huai Nam Han

Luang, 375 m, 16 Mar. 2000, *J. F. Maxwell* 00-141 (BKF, CMUB, L); Chiang Rai, Mae Sai, Doi Tung, 1,300 m, 16 Feb. 2005, *J. F. Maxwell* 05-126 (BKF, CMUB, L); Chiang Rai, Mae Chan, 625 m, 13 Feb. 1991, *J. F. Maxwell, S. Suttajit, W. Pannavalee, and U. Sangsorn* 99 (CMU, L); Phitsanulok, Thung Salaeng Luang National Park, 550 m, 20 Jul. 1966, *K. Larsen, T. Smitinand & E. Warncke* 557 (L), Chiang Rai, Lam Nam Kok National Park, 400 m, 23 Sep. 1967, *K. Iwatsuki, N. Fukuoka, M. Hutoh & D. Chaiglom* T-10888 (BKF, E, L); *ibid.*, *K. Iwatsuki, N. Fukuoka, M. Hutoh & D. Chaiglom* T-10918 (BKF); Phitsanulok, Thung Salaeng Luang National Park, c 300–600 m, 12 Dec. 1965, *M. Tagawa & N. Fukuoka* T-2098 (BKF, L); Chiang Mai, Chiang Dao, Tampha-Plong Temple, 580 m, 5 Apr. 2014, *P. Prommanut & P. Inthachub* P.387 (BK); Chiang Rai, Mueang Chiang Rai, Khunkorn Waterfalls, 680 m, 9 Dec. 1997, *P. Ratchata* 255 (BCU), Nan, Pua, Doi Phu Kha National Park, 1,000 m, 26 Feb. 1997, *R. Pooma, A. Maurie & M. Greijmans* 1415 (BKF, CMUB); Narathiwat, Her Royal Highness Princess Siridhorn Project, 200 m, 21 May 2002, *T. Boonkerd & R. Pollawatn* 276 (BCU); *ibid.*, *T. Boonkerd & R. Pollawatn* 280 (BCU); Nan, Song Khwae, Yod, Tham Sakoen National Park, 19° 22' 46.8" N 100° 32' 19.9" E, 700 m, 10 Feb. 2011, *W. La-onsri and N. Romkham* 1404 (QBG); Lampang, 420 m, *Winit* 902 (K);

**INDIA:** Assam, *Griffith* s.n. (K), *G. Mann* s.n. (P); **MYANMAR:** N Shan States, *J.H. Lace* 4993 (K); **CHINA:** Yunnan, *C.W. Wang* 80044 (PE), *K.M. Feng* 20725 (K, PE), *W.C. Wang* 10347 (K (photo), PE), Hainan, *F.C. How* 72939 (PE, UC); Taiwan, *B.J. Wang* 3850 (TAIF), *I. Simozawa* 269 (TAI), *J.Y. Hwang, C.Y. Hwang* 14 (TAI), *M.L. Weng* 1019, 2023 (TAI), *M.H. Huang* mh1111 (TAIF), *P.F. Lu* 1942, 1943, 1944, 1945, 4968, 5547, 6587, 6649, 9743, 11728, 12217, 12229, 13412, 14136, 15287, 22247 (TAIF), *T.C. Hsu* 428 (TAIF), *U. Faurie* 67 (MICH, TAI), *U. Faurie* 148 (S), *Y.C. Liou* 1363 (TAI), *Y.H. Chang* 20080905-015 (TAIF), *Y.H. Chang* 995 (TAI); **JAPAN:** Ryukyu Islands, *M. Tagawa & K. Iwatsuki* 2211 (P); **VIETNAM:** *M. Poilane* 31393 (L), *Poilane* 7560 (P); **MALESIA:** Peninsular Malaysia, *R.E. Holttum* 20071 (K).

**12. *Tectaria fissa*** (Kunze) Holttum, Fl. Males., Ser. 2, Pterid. 2: 87. 1991; I.M. Turner, Gard. Bull. Singapore 47(1): 54. 1995; S. Linds., D.J. Middleton, Boonkerd & Suddee, Thai For. Bull., Bot. 37: 97. 2009. Type: Java, *Zollinger* 2369 [lectotype L! (photo seen L 0052166), isolectotypes BM! (BM001048596), L! (photo seen L 0052167), photo K! (K000237111)].

*Aspidium fissum* Kunze, Bot. Zeitung 6: 258. 1848. Type: as for above.

*Leptochilus rumicifolius* Ridl., J. Malayan Branch Roy. Asiat. Soc. 4: 116. 1926. Type: Malaysia, Klang Gates, Selangor, *Ridley* s.n. [holotype K! (K000236155)].

*Tectaria rumicifolia* (Ridl.) C. Chr., Index Filic. Suppl. 3: 184. 1934; Holttum, Rev. Fl. Malaya.2: 519. 1955 ['1954']; Dansk Bot. Ark. 23: 241. 1965; Tagawa & K. Iwats., Fl. Thailand 3(3): 380. 1988; Boonkerd & Pollawatn, Pterid. Thailand: 216. 2000. S. Linds., D.J. Middleton, Boonkerd & Suddee, Thai For. Bull., Bot. 37: 98. 2009. Type: as for *A. rumicifolius*.

*Aspidium oligophyllum* Rosenst., Feddes Report. Spec. Nov. Regni Veg. 5: 13. 1908; Alderw., Malayan Ferns: 237. 1908. Type: Sumatra, Indragiri, *Burchard* s.n. [holotype L, isotype UC! (UC 378373)].

*Tectaria oligophylla* (Rosenst.) C. Chr., Index Filic. Suppl. 3: 183. 1934; Holttum, Gard. Bull. Singapore 34: 145. 1981; Subh. Chandra, Taiwania 45(1): 58. 2000. Type: as for *A. oligophyllum*.

*Aspidium burchardii* Rosenst., Meded. Rijksherb. 31: 3. 1917. Type: Sumatra, Burchard 3a [holotype L! (photo seen L 0052165), isotypes B! (B 20 0167577), UC! (photo seen UC 352880), photos BM!, K! (K000237112)].

*Tectaria burchardii* (Rosenst.) C. Chr., Index Filic. Suppl. 3: 177. 1934. Type: as for *A. burchardii*.

*Aspidium divergens* Rosenst., Meded. Rijksherb. 31: 3. 1917. Type: *Cult. Hort. Bog.* [holotype L! (photo seen L 0052157), photos BM!, K!].

*Aspidium tricuspe* Bedd. var. *glabrum* Alderw., Bull. Jard. Bot. Buitenzorg III, 5: 184. 1922. Type: Mt Rani, Riouw Arch., *Bünnemeijer* 5834 (BO).

*Tectaria polymorpha* (Wall. ex Hook.) Copel. var. *cuneifolia* Bonap., Notes Ptérid. 14: 50. 1923; Holttum, Rev. Fl. Malaya ed. 1, 2: 518, f. 304. 1955 [‘1954’]; Tagawa & K. Iwats., Acta Phytotax. Geobot. 23: 56. 1968; Dixit, Census: 144. 1984. — Type: Malaysia, Negri Sembilan, Gurung Lampin, *R.E. Holttum* 9566 [holotype P! (photo seen P01418797), isotype SING!].

*Rhizome* short, erect, densely scaly at apex; *scales* basifixed, bicolored, dark brown centrally with narrowly paler margin, 2–6 × 1–2 mm, lanceolate, apex acuminate, margin subentire. *Fronde*s monomorphic, lamina unipinnate; stipes castaneous to dark dull brown, grooved, 30.0–42.0 cm long, covered with short hairs throughout, scaly at base; lamina ovate, 30.0–36.0 × 27.0–32.0 cm; basal pinnae 15.0–24.0 × 2.5–4.0 cm, stipitate, stalk 1.0–1.5 cm long, subopposite, lanceolate-elliptic, apex acuminate to caudate, base cuneate, margin entire, usually having basiscopic lobe; basal basiscopic lobes 11.0–14.5 × 1.5–2.5 cm, lanceolate, apex acuminate to caudate, base cuneate, margin entire; lateral pinnae 2–4 pairs, stalked at lower pinnae and subsessile upwards, stalks 0.1–1.0 cm long, 10.0–27.0 × 1.5–3.5 cm, opposite or subopposite, lanceolate, apex acuminate to caudate, base cuneate, margin entire, interval 3.5–6.0 cm; terminal pinna 15.0–21.0 × 2.0–5.5 cm, lanceolate-elliptic, apex acuminate to caudate, base cuneate, margin entire; chartaceous, glabrous on both surface except few short hairs on sinus, midrib and main veins, veins fully anastomosing forming irregular areoles with or without free included veinlets, veinlets free, simple, costal areoles having included veinlets. *Sori* round, dorsal on anastomosing veins, arranged in 2 rows between cross veins and irregularly 2–4 rows between main veins; indusia round-reniform, thin, brown, dorsifixed, caducous. **Fig. 4.12.**

Thailand.— PENINSULAR: Songkhla (Khao Nam Khang National Park, Thepha), Yala (Betong, Than To), Narathiwat (Hala-Bala Wildlife Sanctuary).

Distribution.— Malesia [Peninsular Malaysia, Sumatra, Java (type), Borneo].

Ecology.— Terrestrial in deep shade on mountain slopes in evergreen forest at 100–520 m alt.

Note.— This species is closed to *Tectaria polymorpha* (Wall. ex Hook.) Copel. but differing in its lanceolate pinnae shape and narrower pinnae width (up to 4.0 cm wide). According to Flora of Thailand Vol. 3 Part 3 (Tagawa and Iwatsuki, 1988), specimen from Betong district, Yala province was cited. It is noted here that that specimen has not seen in this study.



Specimens examined. — **THAILAND:** Yala, Than To, Ban Chulaphon Phattana 7, Khao Hin Yok, 6° 5' N, 101° 21' E, 520 m, 2 Nov. 2004, *D.J. Middleton, M. Phuphat, R. Pooma & K. Williams* 2951 (BKF, E); Songkhla, Khao Nam Khang National Park, 6° 35' N, 100° 34' E, 180 m, 28 Aug. 1995, *K. Larsen, S.S. Larsen, C. Tange, R. Moran, T. Niyomdham & P. Puudjaa* 46108 (BKF, L); Songkhla, Thepha, 3 Jan. 1989, *Kittima* 48 (KKU); Narathiwat, Waeng, Hala-Bala Wildlife Sanctuary, line 3 of Hala-Bala Wildlife Research Station to Klong Ai Ka Pa, 100 m, 23 Aug. 2006, *M. Poopath, M. Thanaros, T. Weecheanchan, T. Insura* 43 (BKF); *Winit* s.n. (BKF);

**MALESIA: Peninsular Malaysia,** *A. Bidin & R. Jamon* PL 137 (K), *A.G. Piggott* 1485, 2757, 2758, 2765, 2766, 2803, 2804, 2925 (K), *A.S. bin Abdullah* 45 (K), *A.T.N. Ezzawanis* FRI 58133 (L), *B. Molesworth-Allen* 448/57, 1789 (K), *B.S. Parris* 10376, 10969 (K), *B.S. Parris, P.J. Edwards* 10562 (K, L), *C.G. Matthew* s.n. (K), *D.W. Lee* UL-67 (K), *Dr. King's collector* 702, 2395, 7867 (K), *E.S. Hose* 4804 (K), *H.N. Ridley* 14199 (K), *J. Sinclair* 38703 (K), *K. Imin* FRI 74725 (K), *P.J. Edwards* 3654 (K), *R.E. Holttum* 9739, 38410 (K), *R.H. Yapp* s.n. (K), *R. Melville* 4731a (K), *Ridley* s.n. (K), *Y.S. Chao Chao* 2389 (TAIF); **Sumatra,** *Bünnemeijer* 5834, 5943 (L), *Burchard* 3a, s.n. (L), *E. Gardette* 431 (K), *Hendrien Beukema* HB 387, HB 1625, HB 2212 (L), *P. Buwalda* 6889 (K, L); **Java,** *Zollinger* 2369 (BM, L); **Borneo,** *Andiah* 202 (L), *C.J. Brooks* s.n. (K), *Comber* 4139 (K), *Hose* s.n. (P), *K. Iwatsuki, M. Kato, G. Murata & Y.P. Moge* B-1913, B-1924, B-2163, B-2240 (L), *Main* 1948 (L), *M. Hotta* 13298 (L), *M. Kato & H. Wiradinata* B-5258 (L), *M. Kato, M. Okamoto & E. B. Walujo* B-7424 (L), *M. Kato, M. Okamoto & E. B. Walujo* B-10899 (K, L), *O. Posthumus* 2195 (L), *Richards* 2244 (K).

**13. *Tectaria fuscipes*** (Wall. ex Bedd.) C. Chr., Contr. U.S. Natl. Herb. 26: 290. 1931; Ching, *Sinensia* 2(2): 14. 1931; Tagawa & K. Iwats., *S.E. Asian Stud.* 5: 97. 1967; Nayar & Kaur, *Comp. Bedd., Handb.*: 53. 1974; C.M. Kuo, *Taiwania* 30: 28. 1985; Holttum, *Kew Bull.* 43(3): 480. 1988; Tagawa & K. Iwats., *Fl. Thailand* 3(3): 365. 1988; Holttum, *Fl. Males., Ser. 2, Pterid.* 2: 48. 1991; Chandra & Kaur, *Indian Fern J.* 11: 9. 1994; Chandra, *Taiwania* 45(1): 57. 2000; Boonkerd & Pollawatn, *Pterid. Thailand*: 213. 2000; Fraser-Jenkins, *Rev. Three Hund. Ind. Subcont. Pterid.*: 626. 2008; S. Linds., *D.J. Middleton, Boonkerd & Suddee, Thai For. Bull. (Bot.)* 37: 98. 2009; F.W. Xing, Y.H. Yan, S.Y. Dong, F.G. Wang, Christenh. & Hovenkamp, *Fl. China* 2-3: 737. 2013; Patil, Yadav & Dongare, *J. Jpn. Bot.* 89: 187. 2014. Type: India, Assam, *C.B. Clarke* 7050 [holotype K! (K001080698)].

*Aspidium fuscipes* Wall. ex Bedd., *Suppl. Ferns Brit. Ind.*: 15, t. 366. 1876. Type: as for above.

*Nephrodium fuscipes* (Wall. ex Bedd.) C.B. Clarke, *Trans. Linn. Soc. London, Bot.* 1(9): 75. 1880. Type: as for *A. fuscipes*.

*Lastrea fuscipes* (Wall. ex Bedd.) T. Moore ex Bedd., *Handb. Ferns Brit. India*: 243. 1883. Type: as for *A. fuscipes*.

*Ctenitopsis fuscipes* (Wall. ex Bedd.) C. Chr. & Tardieu, *Notul. Syst.* 7: 87. 1938; Ching, *Bull. Fan Mem. Inst. Biol.* 8: 313. 1938; Dickason, *Ohio J. Sci.* 46(3): 121. 1946; Tardieu & C. Chr., *Fl. Indo-Chine* 7(2): 354. 1941; DeVol & Kuo, *Fl. Taiwan* 1: 330. 1975; J.L. Tsai & W.C. Shieh, *Fl. Taiwan*, ed. 2: 286. 1994; S.G. Lu & T.Y.A. Yang, *Taiwania* 50(2): 158. 2005. Type: as for *A. fuscipes*.

*Polypodium pilosum* Roxb., Calcutta J. Nat. Hist. 4: 492. 1844, *nom. illeg. hom.* —  
Type: Bangladesh, Chittagong, *Roxburgh* s.n. [lectotype BR! (photo seen BR0000006984571), photo K!].

*Nephrodium membranifolium* C. Presl var. *dimorpha* C.B. Clarke, Trans. Linn. Soc. London, Bot. 1(8): 535, pl. 75, f. B–C. 1880. Type: India, Sikkim, *C.B. Clarke* 12750 [holotype K! (K001080696)].

*Aspidium membranifolium* (C. Presl) Kunze var. *dimorphum* (C.B. Clarke) Christ, J. Bot. (Morot) 19(3): 4, 62. 1905. Type: as for *N. membranifolium*.

*Ctenitopsis glabra* Ching & Chu H. Wang, Acta Phytotax. Sin. 9(4): 370. 1964. Type: China, Hainan, *H. Fung* 20226 [holotype PE! (photo seen PE 00044729), isotypes BM! (BM001048551), K! (K001080738)].

*Pleocnemia membranifolia* sensu auct. (C. Presl) Bedd., Handb. Ferns Brit. India: 225, f. 115. 1883.

*Sagenia membranifolia* sensu auct. (C. Presl) Christ in Hosseus, Beih. Bot. Centr. 28(2): 366. 1911.

*Tectaria paradoxa* sensu auct. (Fée) Sledge, Kew Bull. 27: 413. 1972, *pro parte*; Bot. J. Linn. Soc. 84: 18. 1982, *pro parte*.

*Rhizome* short, erect to ascending, densely scaly at apex; *scales* basifixed, bicolored, dark brown at central portion with narrow ferruginous paler margin, 4–7 × 1–2 mm, lanceolate, apex acuminate, margin hairy. *Fronde*s monomorphic to slightly dimorphic, fertile fronds usually smaller or with narrower pinnae than sterile fronds; lamina bipinnate at base, bipinnatifid upwards; stipes stramineous to dark dull brown, grooved, 11.0–45.0 cm long, covered with short hairs throughout, usually scaly at base or sometimes throughout; lamina elliptic-oblong, 25.0–65.0 × 20.0–30.0 cm; basal pinnae 10.0–15.0 × 8.0–11.0 cm, stipitate, stalk 0.5–1.5 cm long, ovate-subdeltoid, deeply lobed; basal pinnule 6.0–11.0 × 2.0–2.5 cm, sessile, lanceolate-oblong, apex acuminate, base cuneate, margin deeply lobed to 4/5 towards costules, lobes lanceolate-oblong, apex acute to obtuse, margin subentire to crenate; apical pinnule 1.5–2.0 × 0.5–1.0 cm, lanceolate, apex acute, base round to subtruncate or fused with costule, margin crenate to minutely lobed; terminal pinnule 10.0–12.0 × 5.0–6.0 cm, ovate-subtriangular, asymmetric, apex acuminate, base asymmetrically cuneate, margin deeply lobed to 4/5 towards costule, lobes lanceolate-oblong, apex acute or obtuse, margin subentire to crenate, basal basispic lobes the longest; lateral pinnae up to 10 pairs, alternate to subopposite, stalked at lower pinnae and sessile upwards, stalks 0.1–0.3 cm long, 4.0–14.0 × 1.0–4.0 cm, oblong-lanceolate, apex acuminate, base cordate to subtruncate, margin deeply lobed to 4/5 towards costa, lobes oblong-lanceolate, apex acute, margin subentire to crenate, sometimes falcate, interval 2.0–5.0 cm; terminal pinna 10.5–19.0 × 7.5–8.5 cm, ovate-subdeltoid, apex acuminate, base asymmetrically cuneate, margin lobed to 1/2 towards costa, lobe lanceolate-oblong, apex acute or obtuse, margin subentire to irregularly crenate; chartaceous, pubescent on both surface, covering with short white hairs throughout, densely hairy on costae, costules and midrib, veins all free or partly anastomosing to form costal and costular areoles without free included veinlets, otherwise free, forked. *Sori* round, terminal on free veins, arranged in two rows between main veins; indusia round-reniform, thin, peltate, caducous. **Fig. 4.13.**

Thailand.— NORTHERN: Chiang Mai (Chiang Dao Wildlife Sanctuary, Doi Suthep-Pui National Park, Hang Dong), Chiang Rai (Doi Chong, Doi Luang National

Park, Doi Tung, Lam Nam Kok National Park, Mae Sai, Namtok Khun Khon Forest Park), Nan (Doi Pha Chang Wildlife Sanctuary, Doi Phu Kha National Park, Tham Sakoen National Park, Thung Chang), Lampang (Ngao), Phrae [Rong Kwang (Huay Hom Noi)], Tak (Doi Musoe), Phitsanulok (Thung Salaeng Luang National Park); NORTH-EASTERN: Phetchabun (Nam Nao National Park), Loei (Nong Hin, Phu Kradueng National Park, Phu Luang Wildlife Sanctuary); EASTERN: Chaiyaphum (Phu Khiao Wildlife Sanctuary), Nakhon Ratchasima (Khao Yai National Park); SOUTH-EASTERN: Prachin Buri (Khao Yai National Park), Chonburi (Ban Bueng), Chantaburi (Khao Sra Bhap, Khao Soi Dao Wildlife Sanctuary); SOUTH-WESTERN: Kanchanaburi (Dong Yai, Sai Yok, Thong Pha Phum, Wang Ka).

Distribution.— Nepal, India [Sikkim, Assam (type), Karnataka], Bangladesh (Sylhet, Chittagong), Myanmar, Cambodia, Vietnam, China (Tibet, Yunnan, Guizhou, Guangxi, Hainan, Taiwan), Malesia (Malay Islands, Java, Sulawesi).

Ecology.— Terrestrial in partial shade and moist places on mountain slopes near stream banks in evergreen forest or deciduous forest at 150–1,525 m alt.

Note.— It is noted that totally free or partly anastomosing veins were observed from both fertile and sterile fronds (Tagawa and Iwatsuki, 1988). However, it is noted here that this character should not be used in key to the species.

Specimens examined.— **THAILAND:** Chaiyaphum, Phu Khiao Wildlife Sanctuary, *A. Sathapattayanon* 632 (BCU); *ibid.*, *A. Sathapattayanon* 674 (BCU); *ibid.*, *A. Sathapattayanon* 709 (BCU); Loei, Phu Luang Wildlife Sanctuary, 17° N 101° 40' E, c 950 m, 18 Jan. 1970, *C. F. van Beusekom*, *C. Phengklai* 3064 (BKF, K, L); Phrae, Rong Kwang, Huai Hom Noi, 17 Mar. 1961, *C. Phengklai* 36 (BKF); Kanchanaburi, Dong Yai, 700 m, 14 Aug. 1971, *CP, BS, BN* 2956 (BKF); Nakhon Ratchasima, km 80, 9 Oct. 1968, *Damrongsak* 785 (BKF); Nan, Song Khwae, Tham Sakoen National Park, 675 m, 14 Aug. 2012, *D.J. Middleton, P. Karaket, S. Suddee & P. Triboun* 5588 (BKF, E); Tak, Doi Muser Horticultural Experiment Station, c 800 m, 19 Nov. 1965, *E. Hennipman* 3040 (BKF, L, P); Tak, Doi Muser, c 5 km along road to Tak, 16° 45' N 99° E, c 750 m, 20 Nov. 1965, *E. Hennipman* 3085 (BKF, L); Tak, Doi Pha Wo, 16° 40' N 98° 55' E, c 600 m, 21 Nov. 1965, *E. Hennipman* 3103 (L); *ibid.*, *E. Hennipman* 3106 (BKF, BM, L); Chiang Mai, Doi Suthep-Pui National Park, c 1,050 m, 27 Nov. 1965, *E. Hennipman* 3127A (B, BKF, L); Loei, Phu Luang Wildlife Sanctuary, 17° 25' N 101° 25' E, c 950 m, 8 Jan. 1966, *E. Hennipman* 3538 (BKF, L, P); Nakhon Ratchasima, Khao Yai National Park, Heaw Suwat Waterfalls, 14° 30' N 101° 30' E, c 625 m, 16 Feb. 1966, *E. Hennipman* 3958 (BKF, L); Chiang Mai, Chiang Dao Wildlife Sanctuary, 1,000 m, Oct.-Nov. 1922, *E. Smith* 1090 (K); *ibid.*, 600 m, Oct.-Nov. 1922, *E. Smith* 1091 (K); Tak, c 150 m, Jun. 1924, *E. Smith* 2714 (BM, K); *ibid.*, *E. Smith* 2716 (K); Chaiyaphum, Phu Khiao Wildlife Sanctuary, 16° 28' N 101° 45' E, 850–900 m, 7–9 Nov. 1984, *G. Murata, C. Phengklai, S. Mitsuta, T. Yahara, H. Nagamasu & N. Nantasan* T-49552 (BKF); Phetchabun, Nam Nao National Park, 16° 48–49' N 101° 23–28' E, c 850 m, 28 Oct. 1984, *G. Murata, C. Phengklai, S. Mitsuta, T. Yahara, H. Nagamasu & N. Nantasan* T-51670 (BKF); Chon Buri, Ban Bueng, Ang Chang Nam, 300 m, 1 Sep. 1975, *J.F. Maxwell* 75-957 (BK, L); Chiang Mai, Doi Suthep-Pui National Park, 600 m, 24 Sep. 1987, *J.F. Maxwell* 87-1039 (BKF, L); Chiang Mai, Chiang Dao Wildlife Sanctuary, 800 m, 16 Dec. 1989, *J.F. Maxwell* 89-1542 (CMU, L); Chiang Mai, Mueang Chiang Mai, Doi Suthep-Pui National Park, Mae Sa Botanical Garden, 775 m, 9 Jan. 1990, *J.F.*

Maxwell 90-39 (CMU); *ibid.*, 750 m, 9 Jan. 1990, *J.F. Maxwell* 90-40 (CMU, L); Nan, Ban Luang, Doi Pha Chang Wildlife Sanctuary, 450 m, 5 Aug. 1998, *J.F. Maxwell* 98-817 (BKF); Chantaburi, Khao Soi Dao Wildlife Sanctuary, 700–1,525 m, 8–9 Feb. 1966, *K. Iwatsuki & N. Fukuoka* T-7181 (BKF); *ibid.*, *K. Iwatsuki & N. Fukuoka* T-7194 (BKF, K, L); Chiang Rai, Lam Nam Kok National Park, 400 m, 23 Sep. 1967, *K. Iwatsuki, N. Fukuoka, M. Hutoh & D. Chaiglom* T-10885 (BKF, E, K, L); *ibid.*, *K. Iwatsuki, N. Fukuoka, M. Hutoh & D. Chaiglom* T-10886 (BKF, L); Nan, Doi Phu Kha National Park, Ban Nan Dun, 19° 11' N 101° 4' E, 1,050 m, 9 Nov. 1995, *K. Larsen, S.S. Larsen, C. Tange & D. Sookchaloem* 46375 (BKF); Nan, Thung Chang, Ban Huai Sataeng, NW of Road 1080, c 3 km Soth of the Laotian border, 19° 33' N 100° 53' E, 500 m, 20 Nov. 1993, *K. Larsen, S.S. Larsen, C.T. Nørgaard, K. Pharsen, P. Puudjaa, and W. Uerchirakan* 44666 (K); Phitsanulok, Thung Salaeng Luang National Park, 550 m, 20 Jul. 1966, *K. Larsen, T. Smitinand & E. Warncke* 570 (BKF); Chiang Rai, Doi Chong, 815 m, 28 Nov. 2010, *M. Norsaengsri & N. Tathana* 7362 (QBG); Chiang Rai, Mae Sai, Ban Phamee, Huai Nam Dun, 511 m, 13 Jan. 2011, *M. Norsaengsri & N. Tathana* 7485 (QBG); *ibid.*, 566 m, 13 Jan. 2011, *M. Norsaengsri & N. Tathana* 7520 (QBG); *ibid.*, 597 m, 13 Jan. 2011, *M. Norsaengsri & N. Tathana* 7535 (QBG); Loei, Phu Kradueng National Park, c 1,100 m, 27 Nov. 1965, *M. Tagawa, K. Iwatsuki & N. Fukuoka* T-389 (BKF, L); Loei, Phu Luang Wildlife Sanctuary, from Ban Ba Luang to North ridge, c 900 m, 3 Dec. 1965, *M. Tagawa, K. Iwatsuki & N. Fukuoka* T-1087bis (BKF, L); Loei, Phu Luang Wildlife Sanctuary, 1,100–1,500 m, 4 Dec. 1965, *M. Tagawa, K. Iwatsuki & N. Fukuoka* T-1289 (BKF, L); Phitsanulok, Thung Salaeng Luang National Park, c 300–600 m, 12 Dec. 1965, *M. Tagawa & N. Fukuoka* T-2094 (BKF); Loei, Phu Kradueng, Phu Kradueng National Park, c 1,000 m, *P. Jadprajong* 202 (BCU); Chiang Rai, Khun Korn Waterfalls, 650 m, 18 Oct. 1996, *P. Rachata* 2 (BCU); *ibid.*, 670 m, 18 Oct. 1996, *P. Rachata* 3 (BCU); *ibid.*, 670 m, 30 Dec. 1996, *P. Ratchata* 64 (BCU); *ibid.*, 670 m, 16 Mar. 1997, *P. Ratchata* 141 (BCU); *ibid.*, 670 m, 21 May 1997, *P. Ratchata* 145 (BCU); *ibid.*, *P. Ratchata* 192 (BCU); Nan, Song Khwae, Tham Sakoen National Park, 19° 23' N 100° 32' E, 800 m, 12 May 2006, *P. Srisanga, C. Maknoi, P. Panyachan & P. Tatiya* 2854 (QBG); Chiang Mai, Mueang Chiang Mai, Doi Suthep-Pui National Park, 725 m, 23 Jul. 1993, *P. Thanakorn* 3 (BKF, CMUB, L); Chiang Mai, Chiang Dao Wildlife Sanctuary, c 19° 20' N 98° 50' E, 600–700 m, 5 Jun. 1973, *R. Geesink, D. Phanichapol & T. Santisuk* 5727 (BKF, L); Chiang Mai, Chiang Dao Wildlife Sanctuary, 24 Dec. 2013, *R. Pollawatn* 1567 (BCU); *ibid.*, *R. Pollawatn* 1697 (BCU); Chiang Rai, Doi Tung, 1,300 m, 23 Oct. 1995, *R. Pooma* 1217 (BKF); Kanchanaburi, near Wang Ka, 150 m, 21 May 1946, *S. Bloembergen* 610 (L); *ibid.*, *S. Bloembergen* 621 (BK, K, L); Chiang Rai, Phan, Doi Luang National Park, Pu Kaeng Waterfalls, 19° 26.457' N 99° 41.813' E, 610 m, 5 Dec. 2015, *S. Wongphakdee* 2015-4 (BCU); Chiang Mai, Hang Dong, Nam Pra, Huai Kanin, 16 Oct. 1988, *T. Boonkerd* 18 (BCU); Loei, Nong Hin, Piang Din Waterfalls, 636 m, 20 Jan. 2011, *T. Boonkerd et al.* 2011-40 (BCU); Kanchanaburi, Thong Pha Phum, Lung Lerd Falls, 13 May 2011, *T. Boonkerd et al.* 2011-180 (BCU); Loei, Nong Hin, Piang Din Waterfalls, 636 m, 28 May 2011, *T. Boonkerd et al.* 2011-243 (BCU); Kanchanaburi, Thong Pha Phum, 520 m, 15 Jan. 2003, *T. Boonkerd & R. Pollawatn* 344 (BCU); Loei, Phu Kradueng, Phu Kradueng National Park, 300–1,200 m, 17 Nov. 1979, *T. Shimizu, H. Toyokuni, H. Koyama, T. Yahara & C. Niyomdham*

T-22705 (BKF); Loei, Phu Kradueng National Park, Sum Kae, 1,100 m, 15 Mar. 1952, *T. Smitinand* 1190 (BKF); Tak, Mae Sot, Muser Village, 800 m, 25 Jul. 1959, *T. Smitinand* 6069 (BKF, K, L); Kanchanaburi, Sai Yok, Tao Dam Forest, 350–400 m, 24 Jun. 2001, *T. Vongthavone* 002 (BKF); *ibid.*, *T. Vongthavone* 006 (BK); Chiang Rai, Mueang Chiang Rai, Khun Korn Waterfalls, 1 Sep. 1993, *Winai Somprasong* 168 (BK); Lampang, 430 m, 21 Jan. 1922, *Winit* 35-904 (BKF, K); Lampang, Ngao, 370 m, 26 Aug. 1922, *Winit* 971 (K);

**NEPAL:** *C.R. Fraser-Jenkins* 1303, 1462 (BM); **INDIA:** **Sikkim**, *A.S. Royal* 81 (BM), *C.B. Clarke* 12750 (K), *C.B. Clarke* 36196 (P), *Dr. Jerden* s.n. (K), *G. Panigrahi* 16731 (K), *H.C. Keozeigei* 8205 (K), *J.S. Gamble* 7692 (K); **Assam**, *A.S. Rao* 38977 (L), *Baker* 69 (BM), *C.B. Clarke* 5937, 7050, 7169, 10177, 15812A, 19399, 37816B (K), *C.B. Clarke* 10369, 14962, 15657A (BM), *C.B. Clarke* 15018A, 15208A, 17962, 37816C (K, P), *C.B. Clarke* 37816D (P), *C.J. Simons* s.n. (BM), *C.W. Hope* s.n. (P), *G. Austen* 126, 221 (K), *Griffith* s.n. (K), *G. Mann* s.n. (BM, K, L, P), *J.D.H. & T.T.* 471 (K), *J.F. Duthie* s.n. (K), *M. Buysman* 2134 (P), *R.H. Beddome* 5303 (BM), *Simons* 224 (K), *Wallich* 2032 (K), *W. Riddell* 44 (K); **BHUTAN:** *Nuttall* s.n. (K); **BANGLADESH:** **Sylhet**, *C.B. Clarke* 8406, 17962 (K), *C.B. Clarke* 17933D (BM), *H. & T.T.* s.n. (K), *R.H. Beddome* 7169 (BM), *Wallich* s.n. (K); **Chittagong**, *C.B. Clarke* 19973A (BM), *C.R. Fraser-Jenkins* 30143 (TAIF), *L. Gamble* 7803 (P), *P.F. Lu*, *W.L. Chiou*, *S.J. Moore*, *Y.M. Huang* 16179, 16213 (TAIF), *Roxburgh* s.n. (K); **MYANMAR:** *F.G. Dickason* 7022 (BM), *J.H. Lace* 2936 (K), *Parish* s.n. (K), *Wallich* 361 (K); **CAMBODIA:** *E. Smith* 2692 (K); **VIETNAM:** *B. Balansa* 1791 (K, P), *Bellwrie* 722 (P), *Cadiere* 126 (BM, P), *Cavalerie* 3383 (BM), *Colani* 3391, s.n. (P), *Colani* 3402 (BM, P), *Colani* 3405 (BM), *N.T. Hiep*, *P.K. Loc*, *L. Averyanov* NTH 3858 (K), *Poillane* 25809 (P), *Schmid* VN 1494 (P); **China:** **Guizhou**, *J. Cavalerie* 3383 (K), *J.L. Esquirol* 26 (P), *R.P. Bodinier* s.n. (P); **Guangxi**, *A. Henry* 71 (K), *H.B. Morse* 84 (K); **Hainan**, *H. Fung* 20226 (BM, K, P, PE), *H. Fung* 20093 (K), *S. K. Lau* 3758 (P), *W.T. Tsang* 676 (BM, K); **Taiwan**, *B.J. Wang* 4140, 4382 (TAI), *C.C. Chen* 3231 (TAI), *C.H. Yu*, *M.F. Kao*, *C.I. Hua* 456 (TAI), *C.S. Kuoh* 3977, 4002 (TAI), *C.S. Kuoh* 3989 (BM), *C.M. Kuo* 1909, 7434, 7717, 13831 (TAI), *C.M. Kuo* 13824 (B, TAI), *E. Matsuda* s.n. (TAI), *H.C. Lin* 272 (TAI), *H.L. Chiang* 3749 (TAIF), *H.C. Hung* 613 (TAIF), *M.F. Kao* 3510 (TAI), *M.J. Jung* 165, 2057 (TAIF), *M. Tagawa* 1517 (K, P), *P.F. Lu* 1979, 3524, 3549, 3550, 3551, 7366, 17146, 19802, 19806, 21689, 22092, s.n. (TAIF), *S.J. Yang* 26174 (TAIF), *T. T. Chen et al.* 10715 (TAIF), *T. Y. Yang* 48 (TAI), *Y.C. Lu*, *Y.W. Sang* 1495 (TAIF), *Y.H. Chang* 20080419-003, 20080419-004, 20081125-027, 20081125-028, 20130817-011, 20130817-012, 20130817-013, 20140503-021 (TAIF), *Y.H. Chang* 1012 (TAI), *Y.H. Tzeng* 382, 383 (TAIF); **MALESIA:** **Malay Islands**, *Falconer* s.n. (K); **Java**, *Mousset* 39 (K, P); **Sulawesi**, *E. Smith* 2446 (K), *W. Meijer* 10874 (L).

**14. *Tectaria griffithii*** (Baker) C. Chr., *Index Filic. Suppl.* 3: 180. 1934; *Tardieu & C. Chr.*, *Fl. Indo-Chine* 7(2): 411. 1941, *pro parte*; *C.M. Kuo*, *Taiwania* 30: 29. 1985, *pro parte*; *Holtum*, *Kew Bull.* 43: 484. 1988, *pro parte*; *Tagawa & K. Iwats.*, *Fl. Thailand* 3(3): 370. 1988, *pro parte*, *quoad Winit* 968; *Boonkerd & Pollawatn*, *Pterid. Thailand*: 213. 2000, *pro parte*; *S. Linds.*, *D.J. Middleton*, *Boonkerd & Suddee*, *Thai For. Bull., Bot.* 37: 98. 2009, *pro parte*; *F.W. Xing*,

- Y.H. Yan, S.Y. Dong, F.G. Wang, Christenh. & Hovenkamp, Fl. China 2-3: 738. 2013, *pro parte*; H.H. Ding, Y.S. Chao & S.Y. Dong, Phytotaxa 122(1): 61. 2013. Type: Myanmar, *Griffith* s.n. [lectotype (designated here) K! (K001080693), isoelectotype K! (K001080694)].
- Nephrodium griffithii* Baker in Hook. & Baker, Syn. Fil.: 300. 1867. Type: as for above.
- Sagenia griffithii* (Baker) Bedd., Ferns Brit. India: 337. 1870. Type: as for *N. griffithii*.
- Aspidium griffithii* (Baker) Bedd., Ferns Brit. India: 15. 1876. Type: as for *N. griffithii*.
- Nephrodium cicutarium* (L.) Baker var. *dubia* C.B. Clarke & Baker, J. Linn. Soc., Bot. 24: 417. 1888. Type: India, Assam, *C.B. Clarke* 37819 [holotype K! (K001080699), isotype BM! (BM001048586)].
- Aspidium dubium* (C.B. Clarke & Baker) Bedd., Suppl. Ferns Brit. Ind.: 47. 1892. Type: as for *N. cicutarium* var. *dubium*.
- Tectaria dubia* (C.B. Clarke) Ching, Sinensia 2(2): 23, f. 5. 1931; Subh. Chandra, Fraser-Jenk., Alka Kumari & Archana Sriastava, Taiwania 53(2). 197. 2008; Fraser-Jenk., Bull. Natl. Mus. Nat. Sci., Ser. B 38(4). 176. 2012. Type: as for *N. cicutarium* var. *dubium*.
- Nephrodium yunnanense* Baker, Bull. Misc. Inform. Kew 1906(1): 11. 1906. Type: China, Yunnan, Mengtze, Red River mountains, *W. Hancock* 193 [holotype K! (K000883800), isotype K! (K000883801)].
- Tectaria yunnanensis* (Baker) Ching, Sinensia 2(2): 24. 1931; C.M. Kuo, Taiwania 30. 29. 1985; J.L. Tsai & W.C. Shieh, Fl. Taiwan, ed. 2: 302. 1994; Newman et al., Checkl. Vasc. Pl. Lao PDR: 32. 2007. Type: as for *N. yunnanense*.
- Dryopteris anastomosans* Hayata, J. Coll. Sci. Imp. Univ. Tokyo 30: 414–415. 1911. Type: Randaizan, *T. Kawakami* et *U. Mori* 7136 (*n.v.*).
- Aspidium anastomosans* (Hayata) Hayata, J. Coll. Sci. Imp. Univ. Tokyo 30: 450. 1911. Type: as for *D. anastomosans*.
- Tectaria anastomosans* (Hayata) C. Chr., Index Filic., Suppl. 3: 176. 1934. Type: as for *D. anastomosans*.
- Pleocnemia trimenii* Bedd., forma *dissecta* Alderw., Bull. Jard. Bot. Buitenzorg III 2:: 164. 1920. Type: Sumatra, Sibolangit, *J.A. Lörzing* 5403 (holotype BO, isotype L, photo BM!).
- Tectaria jinpingensis* Ching & Chu H. Wang, Acta Phytotax. Sin. 19(1): 128. 1981. Type: China, Yunnan, Jinping, *Yunnan Complex Exped.* 299 [holotype PE! (photo seen PE01454879)].

*Rhizome* short, erect or ascending, densely scaly at apex; *scales* basifixed, concolorous, dark brown to castaneous, 10–15 × 1.5–2 mm, lanceolate, apex acuminate, margin entire. Fronds monomorphic, lamina pinnatifid, becoming to bipinnate at base and bipinnatifid upwards in mature fronds; stipes dark brown to castaneous, dull, grooved, 15.0–22.0 cm long in immature fronds, 80.0–85.0 cm long in mature fronds, covered with short hairs throughout, densely scaly at base, sometimes throughout with gradually sparse upwards; lamina lanceolate-subtriangular when immature fronds, oblong-subdeltoid in mature fronds, up to 2 × 1 m; basal pinnae up to 50 cm long and 30 cm wide, stalked, stalk 1.0–3.0 cm long, ovate-lanceolate, deeply lobed; basal pinnule 6.0–12.0 × 2.0–4.5 cm, lanceolate-oblong,

apex acuminate, base acute to cuneate or fused with costule, margin subentire to crenate; apical pinnule 8.0–14.0 × 2.0–4.0 cm, lanceolate-oblong, apex acuminate, base acute to cuneate or fused with costule, margin subentire to crenate or lobed; terminal pinnule 28.0–35.0 × 15.0–20.0 cm, ovate-subtriangular, asymmetric, apex acuminate, base asymmetrically cuneate, margin deeply lobed to 4/5 towards costule, lobes oblong-lanceolate, slightly falcate, apex acuminate, margin subentire to slightly crenate; lateral pinnae 3–5 pairs, opposite, stalked at lower pinnae and gradually sessile upwards, stalk 0.5–1.0 cm long, 16.0–27.0 × 6.0–12.0 cm, lanceolate, apex acuminate, base asymmetrically round to cuneate, margin deeply lobed to 1/2–2/3 towards costa, lobes lanceolate-subtriangular, apex acute, margin entire, interval 5.0–10.0 cm; terminal pinna 30.0–35.0 × 22.0–26.0 cm, ovate, apex acuminate, base acute to cuneate, margin deeply lobed to 4/5 towards costa, lobe lanceolate, apex acute to acuminate, subentire to irregularly crenate; chartaceous, glabrous on both surfaces except few short hairs on sinus, midrib and main veins, venation fully anastomosing forming irregular areoles with free included veinlets, veinlets free, usually forked, costal areoles more or less having free included veinlets, veinlets branched. *Sori* round, terminal on free included veinlets, arranged in two rows between main veins; indusia round-reniform, thin, dorsifixed, persistent. **Fig. 4.14.**

Thailand.— NORTHERN: Phrae [Rong Kwang (Mae Sai)]; SOUTH-WESTERN: Ratchaburi [Suan Phueng (Khao Kra Jom)], Phetchaburi (Kaeng Krachan National Park), Prachuap Khiri Khan (Huai Yang Waterfall National Park).

Distribution.— Nepal, Bhutan, India (Assam), China (Sichuan, Yunnan, Guizhou, Guangxi, Hainan, Taiwan), Myanmar (type), Laos, Vietnam.

Ecology.— Terrestrial on humus rich slopes or growing on rocks in shaded place, usually along stream in hill evergreen forest at 800–1,050 m alt.

Note.— Similar to *Tectaria multicaudata* (C.B. Clarke) Ching but differing in its venation pattern and surface. *T. griffithii* is characterized by having fully anastomosing veins with free included veinlets in areoles, costal and costular areoles inconspicuous. On the other hand, *T. multicaudata* has partly anastomosing venation forming costal and costular areoles, without or rarely included free veinlets (Ding et al., 2013). In my study, I examined type specimens both *T. griffithii* and *T. multicaudata* that were deposited at K and I totally agree with the study of Ding et al. (2013). In case of frond surface, I noticed that surface of *T. griffithii* is glabrous on both surfaces except few short hairs in sinus, midrib and main veins whereas *T. multicaudata* has short brown hairs on lamina and densely short brown hairs on midrib and main veins on upper and lower surface. In addition, it is noted here that this is the first time to report *Nephrodium cicutarium* var. *dubia* and its combinations as the synonym of *T. griffithii*.

Specimens examined.— **THAILAND:** Phetchaburi, Kaeng Krachan, Kaeng Krachan National Park, Through forest down behind Phanoen Thung ranger substation, 12.825 N, 99.365 E, 800 m, 13 May 2005, *D.J. Middleton, Chandee Hemrat, Stuart Lindsay, Somran Suddee & Suwat Suwanachat* 3436 (BKF); Ratchaburi, Suan Phueng, Khao Kra Jom, 26 Aug. 2006, *Suan Phueng Trip* 163 (BCU); Phrae, Rong Kwang, Mae Sai, 770–790 m, 30 Nov. 1922, *Winit* 968 (BKF); Prachuap Khiri Khan, Huai Yang Waterfall National Park, 1,050 m, 25 Apr. 1999, *Y. Yuyen* 44 (BCU);

**INDIA:** Assam, *Beddome* s.n. (K), *Bhotan* s.n. (B), *C.B. Clarke* 37819 (BM, K), *E.J.C.* s.n. (K), *G. Mann* 221 (K, L, P), *Mishmee* s.n. (B); **CHINA:** Yunnan, *A. Henry* 10340B (K), *W. Hancock* 193 (K), *Yunnan Complex Exped.* 299 (PE); **Taiwan,** *C.C. Hsu & Kuoh* 13253 (TAI), *Chiang et Liu* 22838 (TAI), *C.W. Chen* Wade202, Wade203, Wade204, Wade752, Wade1520 (TAIF), *C.M. Kuo* 2222, 6706 (TAI), *Do* 196, s.n. (TAI), *H.C. Hung* 397 (TAIF), *I. Simozawa* 773 (TAI), *J.L. Tseng* 15656, 15919 (TAIF), *Kuo et Hu* 15558 (TAI), *L, K, H & C* 581 (TAI), *M.L. Weng* 47, 840, 1929 (TAI), *Matsuda Eizi* s.n. (TAI), *M.F. Kao* 2922, 3967 (TAI), *M.J. Jung* 2004, 5151 (TAIF), *M.T. Kao* 5965 (TAI), *P.H. Lee* 755 (TAIF), *P.F. Lu* 2975, 4071, 4072, 6626, 8484, 14050, 16593, 23900, 23946 (TAIF), *s.coll.* 420 (L), *S.W. Chung* 4846 (TAIF), *S. Sasaki* s.n. (TAI), *Suzuki-Tokio* 14521, 18486 (TAI), *T.C. Hsu* 430 (TAIF), *T.C. Huang & M.T. Kao* 6226, 6301 (TAI), *T.Y. Chiang* 420 (TAI), *W.H. Wu* 688 (TAIF), *W.L. Chiou* s.n. (TAIF), *Y.H. Chang* 997 (TAI), *Y.H. Chang* 20110216-006, 20130728-003, 20130728-004 (TAIF); **MYANMAR:** *Griffith* s.n. (K); **VIETNAM:** *B. Balansa* 1800 (P), *C.W. Chen* Wade2622 (TAIF), *Colani* 2801 (P), *D.K. Harder, P.K. Loc, N.V. Du & N.Q. Hieu* 5384 (P), *H. van der Werff, B. Gray, N.T. Hiep & N.S. Khang* 23881 (P), *L. Averyanov, N.Q. Binh, N.T. Hiep* VH 4335 (P), *Poilane* 3588 (BM), *Poilane* 23523 (P), *Schmid* s.n. (P).

15. *Tectaria gymnosora* Holttum, Dansk Bot. Ark. 23: 308. 1966; Tagawa & K. Iwats., Acta Phytotax. Geobot. 25: 21. 1971; Fl. Thailand 3(3): 382. 1988; Boonkerd & Pollawatn, Pterid. Thailand: 213. 2000. S.Linds., D.J. Middleton, Boonkerd & Suddee, Thai For. Bull., Bot. 37: 98. 2009. Type: Thailand, Phetchabun, Lom Sak, Salaëng Haeng, *B. Hansen, G. Seidenfaden and T. Smitinand* 11225 [holotype C! (photo seen C10020797), isotype K! (K001052225, 2 sheets)].

*Rhizome* short, erect, scaly; *scales* basifixed, bicolored, dark brown at central portion with paler brown ferruginous margin, 7–9 × 1–2 mm, lanceolate, apex acuminate, margin minutely toothed with long filamentous hairs. *Fronde* monomorphic, lamina simple, trilobed when young and becoming to unipinnate when mature; stipes dark brown to castaneous, glossy, grooved, 32.0–76.0 cm long, rarely winged at stipe, usually winged upper the basal pinnae, wing 0.3–1.0 cm wide, becoming narrower towards base, scaly at base; lamina 30.0–50.0 × 24.0–40.0 cm, ovate-elliptic in outline, rachis winged throughout; basal pinnae 15.0–25.0 × 5.5–10.0 cm, elliptic-oblancheolate, apex acuminate, margin entire, more or less having basispic lobe, basispic lobe 3.0–15.0 × 1.5–3.0 cm, linear-lanceolate, apex acuminate, margin entire; lateral pinnae 1–2 pairs or none, 14.0–26.0 × 3.5–5.5 cm, elliptic-oblong, sometimes falcate, apex acuminate, base acute, margin entire or slightly crenate; terminal pinna 18.0–35.0 × 11.0–20.0 cm, ovate-lanceolate in outline, apex acuminate, base cuneate to attenuate, margin entire or trilobed, bearing a large middle lobe and smaller adjacent two lobes, central lobe 15.0–30.0 × 4.0–7.5 cm, elliptic-oblancheolate, apex acuminate, margin entire or slightly crenate, pairs of adjacent lobes 8.0–16.0 × 2.0–5.0 cm, elliptic-oblong, sometimes falcate, apex acuminate, margin entire or slightly crenate; texture papyraceous, glabrous on both surfaces except few short hairs on midrib or main veins beneath, venation anastomosing forming many areoles and areolules with free included veinlets, veinlets simple or forked, costal areoles more or less having free included veinlets. *Sori* round,



dorsal usually on junction of anastomosing veins or on coupling veinlets, arranged in 2 rows between adjacent cross veins and 2–3 irregular rows between main veins, exindusiate. **Fig. 4.15.**

Thailand.— NORTHERN: Nan (Pha Sing); NORTH-EASTERN: Phetchabun [Khao Kho; Lom Sak, Salaëng Haeng (type)], Loei (Na Haeo, Phu Luang Wildlife Sanctuary), Bueng Kan (Phu Wua Wildlife Sanctuary); EASTERN: Chaiyaphum (Phu Khiao Wildlife Sanctuary), Nakhon Ratchasima (Khao Yai National Park, Sakaerat Environmental Research Center); CENTRAL: Nakhon Nayok (Khao Yai National Park); SOUTH-EASTERN: Prachin Buri (Khao Yai National Park).

Distribution.— Vietnam.

Ecology.— Terrestrial on mountain slope in shady area in evergreen forest at 200–900 m alt.

Note.— This species was synonymized as *Tectaria fauriei* Tagawa by Holttum (1986a) but it retained here as the correct name. The absence of wing at stipe, the sori distribution only at junction of anastomosing veins, and the absence of indusia are enough to separate this species from *T. fauriei*.

Specimens examined.— **THAILAND:** Chaiyaphum, Phu Khiao Wildlife Sanctuary, A. *Sathapattayanon* 831 (BCU); Prachin Buri, Khao Yai National Park, 14° 30' N, 101° 30' E, c 700 m, 18 Feb. 1966, E. *Hennipman* 3993 (L); Phitsanulok, Salaëng Haeng, 700 m, 22 Feb. 1964, B. *Hansen*, G. *Seidenfaden* and T. *Smitinand* 11225 (C, K); Nakhon Nayok, Mueang Nakhon Nayok, Khao Yai National Park, c 800 m, 16 Feb. 1966, K. *Iwatsuki* & N. *Fukuoka* T-7388 (BKF); Phetchabun, Khao Kho, Kaeng Ratchapruek, 19 Mar. 2013, *Nachol* T. 036 (BCU); *ibid.*, *Nachol* T. 061 (BCU); *ibid.*, *Nachol* T. 073 (BCU); Loei, Na Haeo, Huaai Nam Phek, c 900 m, 9 Dec. 1996, P. *Suksathan* 066-1 (QBG); Bueng Kan, Bung Khla, Phu Wua Wildlife Sanctuary, nature trail to Lat Plueay Waterfalls, 200 m, 21 May 2004, R. *Pooma*, K. *Phattarahirankanok*, S. *Sirimongkol*, M. *Poopath* 4171 (BKF); Nakhon Nayok, Mueang Nakhon Nayok, Khao Yai National Park, 795 m, 23 Nov. 1999, S. *Chongko* 54 (BKF, L); Nakhon Nayok, Khao Yai National Park, trail to Heaw Narok Waterfalls, *Sirisak* W. 086 (BCU); Nakhon Ratchasima, Khao Yai National Park, trail to Heaw Suwat Waterfalls, 8 Nov. 2014, *Sirisak* W. 087 (BCU); Loei, Phu Luang Wildlife Sanctuary, 2 May 2015, S. *Wongphakdee* 2015-7 (BCU); Nakhon Ratchasima, Sakaerat, 320 m, 10 Jan. 1975, T. *Boonkerd* 528 (BCU); *ibid.*, T. *Boonkerd* 530 (BCU); TS & RGR 7886 (BKF); Nakhon Ratchasima, Khao Yai National Park, Pha Kluai Mai Waterfalls, 8 Sep. 2007, W. *Khwaiphan* 185 (BCU); Loei, Na Haeo, 680 m, 9 Dec. 1996, W. *Nanakorn et al.* 8058 (QBG); Nan, Mueang Nan, Pha Sing, 13 Jun. 1993, *Winai Somprasong* 325 (BK);

**VIETNAM:** *Schmid* VN 253, s.n. (P).

**16. *Tectaria hennipmanii*** (Tagawa & K. Iwats.) S.Y. Dong, *Phytotaxa* 178(3): 226. Type: Thailand, Tak, Doi Muser Agricultural Experimental Station (current name is Doi Muser Horticultural Experimental Station), E. *Hennipman* 3060 [holotype L! (L 0051694), isotype BKF! (SN083478)].

*Heterogonium hennipmanii* Tagawa & K. Iwats., *Acta Phytotax. Geobot.* 26: 59, f. 15. 1974; Holttum, *Kalikasan* 4: 216. 1975; Tagawa & K. Iwats., *Fl. Thailand* 3(3): 362. 1988; Boonkerd & Pollawatn, *Pterid. Thailand*: 206. 2000; S.

Linds., D.J. Middleton, Boonkerd & Suddee, Thai For. Bull., Bot. 37: 96. 2009. Type: as for *T. hennipmanii*.

*Rhizome* unknown. *Fronde*s slightly dimorphic, fertile fronds usually smaller or with narrower pinnae than sterile fronds, lamina bipinnatifid; stipes castaneous to dull brown, grooved adaxially, up to 45.0 cm long in sterile fronds and up to 30.0 cm long in fertile fronds, minutely pubescent throughout, densely scaly at base, scales persistent, concolorous, pale brown to light brown, 10–13 × 2.5–3.5 mm, oblong-lanceolate, apex acuminate, margin hairy, consisting with numerous minute hairs; lamina known only in the lower portion, oblong-lanceolate, up to 35 cm wide near base in sterile fronds and up to 60.0 × 25.0 cm in fertile fronds; basal pinnae up to 15.0 × 4.0 cm in sterile fronds and fertile fronds, shorter than upper pinnae and basal basisopic lobe not the longest, very shortly stalked, linear-lanceolate, apex acuminate, base broadly cuneate to subcordate, margin deeply lobed to 1/2 towards costa, lobes 0.8–1.8 × 0.5–1.0 cm, oblong, apex obtuse, margin entire; upper lateral pinnae up to 14 pairs, 15.0–20.0 × 3.0–3.5 cm in sterile fronds and 9.0–16.0 × 1.5–2.5 cm in fertile fronds, opposite or subopposite, sessile, linear-lanceolate, broadest in middle, apex acuminate, gradually narrowing towards, base broadly cuneate to subcordate, margin deeply lobed to 1/2 towards costa, lobes 0.8–1.5 × 0.5–1.0 cm, oblong, apex obtuse, margin entire or minutely undulate; chartaceous, glabrous on both surfaces except few short hairs on midrib and main veins beneath, venation in sterile fronds mostly free, forked, somewhat forming costal areoles without free included veinlets and venation in fertile fronds all free, forked. *Sori* round, terminal on short acroscopic branch of veinlets, usually arranged in one row at each side of main veins or subcostular portion; indusia dorsifixed, stiff, round-reniform, brown, persistent. **Fig. 4.16.**

Thailand.— NORTHERN: Nan (Doi Phu Kha National Park), Tak [Doi Muser Horticultural Experimental Station (Type)].

Distribution.— Endemic.

Ecology.— Terrestrial along streamlet in moist evergreen forest at 800–1,300 m alt.

Note.— Only two incomplete specimens were found.

Specimens examined.— **THAILAND:** Tak, Doi Muser Horticultural Experimental Station, 16° 45' N 99° E, c 800 m, 19 Nov. 1965, *E. Hennipman* 3060 (BKF, L), Nan, Bo Kluea, Doi Phu Kha National Park, E side of Doi Ya Wai, 19° 11' N 101° 16' E, 1,300 m, 21 Nov. 1993, *K. Larsen*, *S.S. Larsen*, *C.T. Nørgaard*, *K. Pharsen*, *P. Puudjaa*, and *W. Uerchirakan* 44670 (L).

**17. *Tectaria herpetocaulos*** Holttum, Dansk Bot. Ark. 23: 241. 1965; Rev. Fl. Malaya, ed. 2, 2: 636. 1968; Tagawa & K. Iwats., S. E. Asian Stud. 5: 99. 1967; Fl. Thailand 3(3): 379. 1988; Holttum, Fl. Males., Ser. 2, Pterid. 2: 89. 1991; I.M. Turner, Gard. Bull. Singapore 47(1): 54. 1995; Boonkerd & Pollawatn, Pterid. Thailand: 213. 2000; S.K. Wu, Acta Phytotax. Sin. 40(6): 534. 2002; Newman et al., Checkl. Vasc. Pl. Lao PDR: 32. 2007; S. Linds., D.J. Middleton, Boonkerd & Suddee, Thai For. Bull., Bot. 37: 98. 2009; F.W. Xing, Y.H. Yan, S.Y. Dong, F.G. Wang, Christenh. & Hovenkamp, Fl. China 2–3: 739. 2013. Type: Malaysia, *B. Molesworth-Allen* 4454 [holotype K! (K000236259),

isotypes A! (photo seen A00022150), K! (K000236260, K000236261, K000236262, K000236263)].

*Tectaria polymorpha* (Wall. ex Hook.) Copel. var. *subcuneata* Ching & Chu H. Wang, Acta Phytotax. Sin. 19(1): 129. 1981; S.K. Wu, Acta Phytotax. Sin. 40(6): 534. 2002. Type: China, Yunnan, *Yunnan Complex Exped.* 5891 [holotype PE! (photo seen PE00050312), isotype KUN].

*Tectaria simaoensis* Ching & Chu H. Wang, Acta Phytotax. Sin. 19(1): 130. 1981. Type: China, R.C. Ching 595 [holotype PE! (photo seen PE00044752)].

*Tectaria polymorpha* sensu auctt. Tagawa & K. Iwats. [non (Wall. ex Hook.) Copel., 1907], Dansk Bot. Ark. 23: 240. 1965, *pro parte, quoad A.F.G. Kerr 11780, K. Larsen 9512*; S. E. Asian Stud. 5: 99. 1967, *pro parte, quoad K. Iwatsuki & N. Fukuoka T-3422, T-7321, M. Tagawa, K. Iwatsuki & N. Fukuoka T-1899, T-4078*; Acta Phytotax. Geobot. 23: 56. 1968, *pro parte, quoad E. Smith 1844*; Fl. Thailand 3(3): 378. 1988, *pro parte*; Boonkerd & Pollawatn, Pterid. Thailand: 215. 2000, *pro parte*; S. Linds., D.J. Middleton, Boonkerd & Suddee, Thai For. Bull., Bot. 37: 98. 2009, *pro parte*.

*Rhizome* creeping, densely scaly; *scales* basifixed, bicolored, dark brown centrally with narrowly paler margin, 2–5 × 1–1.5 mm, lanceolate, apex acuminate, margin subentire. *Fronde*s monomorphic to slightly dimorphic, fertile fronds much longer and narrower than sterile fronds, lamina unipinnate; stipes stramineous to dull brown, grooved adaxially, (23.0–)42.0–65.0(–96.5) cm long, covered with short hairs throughout, scaly at base; lamina oblong-ovate, 30.0–46.0 × 26.0–54.0 cm; basal pinnae 13.0–29.0 × 6.0–15.5 cm, stalked, stalk 0.3–1.0 cm long, opposite or subopposite, asymmetric, ovate-elliptic, sometimes falcate, apex acuminate, base asymmetrically round, more or less having basisopic lobe; basal basisopic lobes 16.0–21.0 × 3.5–8.0 cm, elliptic-oblong, apex acuminate, base round or slightly cuneate, margin entire or sometimes crenate; lateral pinnae 2–4 pairs, stalked at lower pinnae and sessile upwards, stalks 0.1–0.6 cm long, 12.5–30.0 × 2.5–7.5 cm, opposite or subopposite, elliptic-oblong, often falcate, apex acuminate to caudate, base asymmetrically round, margin entire or sometimes irregularly crenate, interval 3.5–7.0 cm; terminal pinna 12.5–30.0 × 5.0–12.5 cm, elliptic-ovate, apex acuminate, base acute to cuneate, margin entire or sometimes irregularly crenate; chartaceous, glabrous on both surface except few short hairs on sinus, midrib and main veins, veins fully anastomosing forming irregular areoles with free included veinlets, veinlets free, simple or forked, costal areoles having branched included veinlets. *Sori* round, dorsal on anastomosing veins, arranged in two rows between cross veins, in irregular 2–6 rows between lateral veins; indusia round-reniform, thin, brown, dorsifixed, caducous.

**Fig. 4.17.**

Thailand.— NORTHERN: Mae Hong Son (Mae La Noi, Mae Sariang, Pang Mapha), Chiang Mai (Chai Prakan, Chiang Dao Wildlife Sanctuary, Doi Pha Hom Pok National Park, Doi Suthep-Pui National Park, Fang, Galyani Vadhana, Mae On, Mae Rim, Tha Ton, Wiang Haeng), Chiang Rai (Ban Lang Lat, Doi Luang National Park, Doi Tung, Mae Chan, Mae Suai, Namtok Khun Kon Forest Park), Phayao (Doi Luang National Park, Doi Pha Chang Wildlife Sanctuary), Nan (Tham Sakoen National Park, Thung Chang), Lamphun (Doi Khun Tan National Park), Lampang (Chae Son National Park, Doi Luang National Park), Phrae (Rong Kwang (Huai Rong), Mae Yom NP), Tak (Doi Musoe, Mae Sot), Sukhothai (Ramkhamhaeng

National Park), Phitsanulok (Phu Soi Dao National Park), Kamphaeng Phet (Khlong Lan National Park); NORTH-EASTERN: Phetchabun (Nam Nao National Park), Loei (Na Haeo, Phu Kradueng National Park, Phu Luang Wildlife Sanctuary, Phu Ruea National Park), Sakon Nakhon (Phu Phan National Park); EASTERN: Chaiyaphum (Nam Phrom, Phu Khiao Wildlife Sanctuary), Nakhon Ratchasima (Khao Yai National Park, Sakaerat); CENTRAL: Saraburi (Muak Lek), Nakhon Nayok (Khao Yai National Park); SOUTH-EASTERN: Prachin Buri [Khao Yai National Park, Na Di (Bu Phram)], Chonburi, (Khao Kheow Open Zoo), Chantaburi (Khao Soi Dao Wildlife Sanctuary, Namtok Phlio National Park); SOUTH-WESTERN: Kanchanaburi (Sai Yok, Sangkhla Buri, Si Sawat, Song Tho, Tham Nam, Thung Kang Yang Hill, Thung Yai Naresuan Wildlife Sanctuary), Ratchaburi (Suan Phueng), Phetchaburi (Kaeng Krachan National Park), Prachuap Khiri Khan (Hua Hin, Huai Yang Waterfall National Park, Kui Buri National Park); PENINSULAR: Chumphon (Bang Son, Phato), Surat Thani (Ko Tao), Nakhon Si Thammarat (Khao Luang National Park, Khao Nan National Park), Phuket (Ton Sai Waterfalls), Yala (Betong).

Distribution.— India (Andaman Islands), China (Yunnan), Myanmar, Cambodia, Vietnam, Malesia [Peninsular Malaysia (type), Borneo].

Ecology.— Terrestrial on shaded mountain slopes in dry evergreen forest or mixed deciduous forest at 150–1,250 m alt.

Vernacular.— Goot hua lhek (กูดหัวเหล็ก) (Northern); Sang Korani (สังกระณี) (North-Eastern).

Uses.— Note on the specimen kept at BKF (*Din* 3), its rhizome can be used for curing fever by boiling.

Note.— Very similar to *Tectaria polymorpha* (Wall. ex Hook.) Copel. but differing in its creeping rhizomes and abaxially glabrous laminae.

Specimens examined.— **THAILAND:** Chiang Mai, Chiang Dao Wildlife Sanctuary, 6 Nov. 1963, *Adisai* 607 (BK); Loei, Phu Kradueng National Park, c 900 m, 11 Mar. 1924, *A.F.G. Kerr* 8447 (BK, BM); *ibid.*, *A.F.G. Kerr* 8647 (K); Prachin Buri, Na Di, Bu Phram, 1,300 m, 3 Jan. 1925, *A.F.G. Kerr* 9830 (BK, BM, K); Surat Thani, Ko Tao, c 200 m, 22 Jul. 1927, *A.F.G. Kerr* 12994 (BK, BM, K); Saraburi, Muak Lek, 300 m, 2 May 1922, *A. Marcan* 840 (BM); Chaiyaphum, Phu Khiao Wildlife Sanctuary, *A. Sathapattayanon* 697 (BCU); Phetchabun, Nam Nao National Park, 12 Nov. 2011, *A. Tharasena, K. Magkomol* 945 (KKU); Tak, Bhumibol Dam, 750 m, 14 Jun. 1959, *Boonnag* 632 (BCU); Loei, Phu Luang Wildlife Sanctuary, 17° N 101° 40' E, c 950 m, 18 Jan. 1970, *C.F. van Beusekom, C. Phengklai* 3059 (BKF, K, L); Phrae, Mae Khaem stream, 18° 7' N 100° 9' E, 440 m, 5 Jan. 1972, *C.F. van Beusekom, C. Phengklai, R. Geesink, B. Wongwan* 4656 (BKF); Phrae, Rong Kwang, Huai Rong, 200 m, 1 Jun. 1972, *C.F. van Beusekom, C. Phengklai, R. Geesink, B. Wongwan* 4685 (B, BKF, BM, L); Chon Buri, Khao Kheow Open Zoo, c 300 m, 7 Aug. 2000, *C. Phengklai et al.* 12592 (BKF); *ibid.*, 12 Sep. 2000, *C. Phengklai et al.* 12843 (BKF); Phetchaburi, Kaeng Krachan, Kaeng Krachan National Park, Trail from near Khao Phanoen Thung ranger substation towards KU Camp on Phetchaburi River, 12° 50.8' N 99° 19.5' E, 370 m, 27 Mar. 2003, *D.J. Middleton, C. Hemrat, S. Lindsay, S. Suddee & S. Suwanachat* 1719 (BKF); *ibid.*, on steep slope down from road on the way to Phanoen Thung ranger substation, 712.811 N, 99.393 E, 700 m, 5 Sep. 2005, *D.J. Middleton, C. Hemrat, S. Lindsay, S. Suddee & S.*

*Suwanachat* 3306 (BKF); Chiang Mai, Chiang Dao, Chiang Dao Wildlife Sanctuary, way to Mueang Kong, 975 m, 20 Sep. 2008, *D.J. Middleton, P. Karaket, P. Triboun, U. Kawatkul & R. Meeboonya* 4528 (BKF); Chantaburi, Mueang Chantaburi, Namtok Phlio National Park, Khlong Narai Waterfalls, 12° 34' 9" N 102° 10' 7" E, 140 m, 9 Jan. 2009, *D.J. Middleton, P. Karaket, S. Lindsay, T. Phutthai and S. Suddee* 4653 (BKF, E); Chantaburi, Soi Dao, Khao Soi Dao Wildlife Sanctuary, trail up mountain from Sanctuary headquarters, 13° 5.4' N 102° 10.3' E, 350 m, 13 Jan. 2009, *D.J. Middleton, P. Karaket, S. Lindsay, T. Phutthai and S. Suddee* 4696 (BKF, E, QBG); *ibid.*, trail up mountain from Sanctuary headquarters, 13° 4' 9" N 102° 10' 1" E, 550 m, 13 Jan. 2009, *D.J. Middleton, P. Karaket, S. Lindsay, T. Phutthai and S. Suddee* 4701 (BKF, E); Prachuap Khiri Khan, Kui Buri, Kui Buri National Park, Trail above park headquarters, 700 m, 23 Jan. 2004, *D.J. Middleton, R. Namdang, R. Pooma, S. Suddee, S. Suwanachat, K. Williams* 2442 (BKF); Phetchaburi, Kaeng Krachan, Kaeng Krachan National Park, on ridge from ranger substation towards summit of Khao Phanoen Thung, 12° 50' N 99° 22' E, 880 m, 13 Dec. 2002, *D.J. Middleton, S. Suddee & C. Hemrat* 1621 (BKF, CMUB, L); Loei, Phu Kradueng National Park, Sam Khrae, 800 m, 18 May 1948, *Din* 3 (BKF); Tak, Doi Muser Horticultural Experimental Station, 16° 45' N 99° E, c 800 m, 19 Nov. 1965, *E. Hennipman* 3046 (L); *ibid.*, *E. Hennipman* 3057 (BM, BKF, L, P); Tak, Doi Muser, c 5 km along road to Tak, c 750 m, 20 Nov. 1965, *E. Hennipman* 3082 (BKF, L, P); Chiang Mai, Chiang Dao Wildlife Sanctuary, c 600–900 m, 8 Dec. 1965, *E. Hennipman* 3311 (BKF, L); Mae Hong Son, Mae La Noi, 18° 25' N 97° 55' E, c 375 m, 27 Dec. 1965, *E. Hennipman* 3489 (BKF); Loei, Phu Luang Wildlife Sanctuary, 17° 25' N 101° 25' E, c 900 m, 11 Jan. 1966, *E. Hennipman* 3629 (BKF, L); Nakhon Ratchasima, Khao Yai National Park, Heaw Suwat Waterfalls, 14° 30' N 101° 30' E, c 625 m, 16 Feb. 1966, *E. Hennipman* 3961 (BKF, L); Mae Hong Son, Pang Mapha, km 145 of highway 1095, 19° 33' N 98° 17' E, 11 Jun. 1989, *E.F. Anderson* 5964 (CMU); Chiang Mai, Chiang Dao Wildlife Sanctuary, 600 m, Oct.-Nov. 1922, *E. Smith* 1174 (BK), Phuket, Ton Sai Waterfalls, 24 Jan. 1986, *G. & U. Benl* 65b (K); Chaiyaphum, Phu Khiao Wildlife Sanctuary, 16° 28' N 101° 45' E, 850–900 m, 7 Nov. 1984, *G. Murata, C. Phengklai, S. Mitsuta, T. Yahara, H. Nagamasu & N. Nantasan* T-49553 (BKF); Phetchabun, Nam Nao National Park, c 850 m, 28 Oct. 1984, *G. Murata, C. Phengklai, S. Mitsuta, T. Yahara, H. Nagamasu & N. Nantasan* T-51673 (BKF, QBG); Nakhon Ratchasima, Khao Yai National Park, c 600–800 m, 19 Jul. 1973, *G. Murata, N. Fukuoka & C. Phengklai* T-16399 (BKF); Chiang Mai, Mae Ai, Tha Ton, c 440 m, 15 Mar. 1925, *H.B.G. Garrett* 222 (BCU, BKF, BM); Kanchanaburi, Khao Laem Dam, Ban Tha Khanun, 1 Nov. 1985, *H. Koyama, F. Konta & W. Nanakhorn* T-48999 (BKF); Chiang Mai, Mae Rim, Pong Yaeng, Pong Yaeng Nao, Pha Dha Cave, 900 m, 1 Sep. 2003, *J.F. Maxwell* 03-257 (CMUB, L); Mae Hong Son, Pang Mapha, Tham Lot, Mueang Pam Village, Doi Pha Bao, 775 m, 12 Nov. 2004, *J. F. Maxwell* 04-705 (BKF, CMUB); Chiang Mai, Mae On, Huai Kaeo, Doi Lon, 1,075 m, 23 Nov. 2004, *J.F. Maxwell* 04-737 (BKF, CMUB); Chiang Rai, Mae Sai, Doi Tung, 1,375 m, 19 Oct. 2006, *J.F. Maxwell* 06-724 (CMUB); Kanchanaburi, Sangkhla Buri, Muang Cha, 800 m, 8 Jul. 1973, *J.F. Maxwell* 73-213 (BK), Chantaburi, Khao Soi Dao Wildlife Sanctuary, 500 m, 5 Jul. 1974, *J.F. Maxwell* 74-666 (BK, L); Chiang Rai, Mae Chan, Ban Mai Pattana, 900 m, 22 Aug. 1985, *J.F. Maxwell* 85-798 (L, PSU); Chiang Mai, Mueang Chiang Mai, Doi Suthep-Pui National Park, 650 m, 1

Aug. 1987, *J.F. Maxwell* 87-753 (BKF, CMU, L); Chiang Mai, Chiang Dao, Chiang Dao Wildlife Sanctuary, 550 m, 22 Jan. 1989, *J.F. Maxwell* 89-83 (BKF, CMU, L); Chiang Mai, Mueang Chiang Mai, Doi Suthep-Pui National Park, 1,100 m, 26 Oct. 1988, *J.F. Maxwell* 88-1242 (CMU, L); *ibid.*, 800 m, 28 Aug. 1990, *J.F. Maxwell* 90-921 (CMU, L); Phayao, Mueang Phayao, Doi Luang National Park, 600 m, 29 Nov. 1991, Huai Champa Thong Station, *J.F. Maxwell* 91-1078 (CMUB, E, L); Mae Hong Son, Mae Sariang, Mae Ho, Ban Mae Sawan Noi Stream, 1,125 m, 3 Mar. 1991, *J.F. Maxwell* 91-226 (CMU, E, L); Chiang Mai, Chai Prakan, Si Dong Yen, Ban Wieng Pa Pattana, 725 m, 8 Jul. 1991, *J.F. Maxwell* 91-618 (CMU, E, L, P); Chiang Mai, Doi-Suthep-Pui National Park, Chang Kian Valley, 1,050 m, 8 Jul. 1993, *J.F. Maxwell* 93-743 (BCU, BKF, L); Phrae, Song, Mae Yom National Park, 400 m, 15 Dec. 1993, *J.F. Maxwell* 93-1516 (CMUB, L); Kanchanaburi, Sangkhla Buri, Thung Yai Naresuann Wildlife Sanctuary, Lai Wo, Ban Saneh Pawng, 200 m, 12 Aug. 1993, *J. F. Maxwell* 93-883 (BKF, CMUB, L); Lamphun, Mae Tha, Doi Khun Tan National Park, 1,200 m, 20 Nov. 1993, *J. F. Maxwell* 93-1415 (BKF, CMUB, L); Sukhothai, Khiri Mat, Ramkhamhaeng National Park, 275 m, 27 Jan. 1995, *J.F. Maxwell* 95-11 (BKF, CMUB, L); Chiang Mai, Wiang Hang, 1,000 m, 19 Apr. 1995, *J.F. Maxwell* 95-347 (BCU, BKF, L); Chiang Mai, Galyani Vadhana, Ban Chan, Mae Pha Boo Vilage, 850 m, 24 May 1995, *J.F. Maxwell* 95-440 (BKF, CMUB, L); Lampang, Mueang Pan, Chae Son National Park, 875 m, 21 Oct. 1995, *J.F. Maxwell* 95-935 (BKF, CMUB, L); Phayao, Mueang Phayao, Doi Luang National Park, Champa Thong Waterfalls, 600 m, 6 May 1997, *J.F. Maxwell* 97-462 (BKF, CMUB, L); Phayao, Pong, Doi Pha Chang Wildlife Sanctuary, 800 m, 3 Aug. 1998, *J.F. Maxwell* 98-782 (BKF, CMUB, L); Phetchabun, Nam Nao National Park, 12 Dec. 2003, *J. Thangthong* 497 (KKU); *ibid.*, *J. Thangthong* 499 (KKU); *ibid.*, *J. Thangthong*, *K. Makgomol* 498 (KKU); Chiang Mai, Chiang Dao Wildlife Sanctuary, 7 Jan. 1958, *K. B.* 890 (BKF); *ibid.*, 11 Mar. 1962, *K. Bunchuai* 1169 (BKF); Chiang Rai, Mae Suai, Ban Saen Sa-at, 28 Jul. 1967, *K. Bunchuai & B. Nimanong* 1439 (BKF, K, L); Phetchabun, Nam Nao National Park, Dong Pak, 21 Oct. 2005, *Kittima, Bang-on* 596 (KKU); *ibid.*, *Kittima, Bang-on* 597 (KKU); *ibid.*, *Kittima, Bang-on* 598 (KKU); Chiang Rai, interior of Ban Lang Lat, along the upper course of Nam Mae Lao, 900–1,200 m, 25 Dec. 1965, *K. Iwatsuki & N. Fukuoka* T-3422 (BKF); Chantaburi, Khao Soi Dao Wildlife Sanctuary, 200–700 m, 2 Oct. 1966, *K. Iwatsuki & N. Fukuoka* T-7321 (BKF); Chiang Rai, Lam Nam Kok National Park, 400 m, 23 Sep. 1967, *K. Iwatsuki, N. Fukuoka, M. Hutoh & D. Chaiglom* T-10917 (BKF); Chiang Rai, Doi Tung, en route from Ban Huai Khrai to Wat Doi Tung, c 700 m, 24 Sep. 1967, *K. Iwatsuki, N. Fukuoka, M. Hutoh & D. Chaiglom* T-11009 (BKF, P); Kanchanaburi, Si Sawat, Klang Dong, 600 m, 28 Jan. 1962, *K. Larsen* 9326 (BKF, K); Kanchanaburi, Thung Kang Yang Hills, 500 m, 7 Jul. 1963, *K. Larsen* 10565 (K); Nakhon Si Thammarat, Khao Luang National Park, 700 m, 23 Aug. 1995, *K. Larsen, S.S. Larsen, C. Tange, R. Moran, T. Niyomdham & P. Puudjaa* 45871 (BKF); Nan, Thung Chang, Ban Huai Sataeng, NW of highway 1080, c 3 km south of the Laotian border, 19° 33' N, 100° 53' E, 500 m, 20 Nov. 1993, *K. Larsen, S.S. Larsen, C.T. Nørgaard, K. Pharsen, P. Puudjaa, and W. Uerchirakan* 44655 (BKF); Nakhon Ratchasima, Khao Yai National Park, 400 m, 8 Oct. 1968, *K. Larsen, T. Santisuk & E. Warncke* 3248 (BKF, E); *K. Larsen, T. Smitinand* 9511 (BKF); Loei, Phu Kradueng National Park, c 900 m, 27 Nov. 1965, *M. Tagawa, K. Iwatsuki & N. Fukuoka* T-377 (BKF, L); *ibid.*, c

1,100 m, 27 Nov. 1965, *M. Tagawa, K. Iwatsuki & N. Fukuoka* T-397 (BKF); Loei, Phu Luang Wildlife Sanctuary, from Ban Na Luang to North ridge, c 800 m, 3 Dec. 1965, *M. Tagawa, K. Iwatsuki & N. Fukuoka* T-1092 (BKF, E, L); *ibid.*, interior of Nam Thop, 400–850 m, 12 Jul. 1965, *M. Tagawa, K. Iwatsuki & N. Fukuoka* T-1899 (BKF, L); Chiang Mai, Chiang Dao Wildlife Sanctuary, 500–1,600 m, 1 Mar. 1966, *M. Tagawa, K. Iwatsuki & N. Fukuoka* T-4078 (BKF); Tak, Ban Muser, 750–900 m, 31 Aug. 1967, *M. Tagawa, K. Iwatsuki, H. Koyama & A. Chintayungkun* T-8593 (BKF, L, P); Chiang Mai, Chiang Dao Wildlife Sanctuary, 500–600 m, 11 Sep. 1967, *M. Tagawa, T. Shimizu, H. Koyama, M. Hutoh & A. Nalampoon* T-9768 (BKF, E, L, P); Sakon Nakhon, Phu Phan National Park, 4 Sep. 2008, *N.R. Srathongjai & K. Makgomol* P2008-28 (KKU); Phayao, Mueang Phayao, Doi Luang National Park, Champa Thong Waterfalls, 600 m, 23 Jan. 1998, *O. Petrmitr* 260 (BKF, CMUB, L); Sakon Nakorn, Phu Phan National Park, *P. Chantaranothai et al.* 1259 (KKU); Loei, Phu Luang Wildlife Sanctuary, 17° 9' N 101° 41' E, 29 Sep. 1990, *P. Chantaranothai, J. Parnell & D. Simpson* 90/467 (K, KKU); Loei, Phu Rua National Park, Dong Phab Pran, 17° 28' N 101° 18' E, 750 m, 5 Mar. 1993, *P. Chantaranothai, D. Middleton, J. Parnell & D. Simpson* 1093 (K); Loei, Phu Kradueng National Park, 18 Dec. 2014, *P. Jadprajong* 44 (BCU); *ibid.*, *P. Jadprajong* 189 (BCU); Chiang Rai, Khun Korn Waterfalls, 670 m, 18 Oct. 1996, *P. Ratchata* 15 (BCU); *ibid.*, 750 m, 16 Mar. 1997, *P. Ratchata* 131 (BCU); *ibid.*, 1,250 m, 12 Aug. 1998, *P. Ratchata* 295 (BCU); Chiang Rai, Mae SUai, Ban San Sa At, 22 Jul. 1967, *Prayad* 933 (BK); Loei, Na Haeo, Huai Nam Phek, c 900 m, 9 Dec. 1996, *P. Suksathan* 066 (QBG); Tak, Mae Sot, Phra Wo, highway 108 from Tak to Mae Sot, 16.464000 N 98.410300 E, 770 m, 22 Mar. 2005, *R. Pooma, K. Phattarahirankanok, S. Sirimongkol, M. Poopath* 5025 (BKF); Chumphon, Bang Son, 12 Sep. 1927, *Put* 1075 (K); Tak, c 150 m, Jun. 1924, *Put for Eryl Smith* 2719 (K); Tak, 20 km E of Mae Sot, 500–700 m, 30 May 1973, *R. Geesink, D. Phanichapol & T. Santisuk* 5564 (BM, L); Chiang Mai, Chiang Dao Wildlife Sanctuary, 22 Dec. 2013, *R. Pollawatn* 1541 (BCU); *ibid.*, 23 Dec. 2013, *R. Pollawatn* 1568 (BCU); *ibid.*, Pa Ban Yang Waterfalls, 25 Dec. 2013, *R. Pollawatn* 1590 (BCU); Chiang Mai, Chiang Dao Wildlife Sanctuary, *R. Pollawatn* 1694 (BCU); *ibid.*, *R. Pollawatn* 1695 (BCU); *ibid.*, *R. Pollawatn* 1696 (BCU); *ibid.*, *R. Pollawatn* 1737 (BCU); *ibid.*, *R. Pollawatn* 1739 (BCU); Chiang Mai, Mae Rim, Mae Sa Botanical Garden, 700 m, 20 Jan. 1989, *R. Pooma* 178 (BKF, CMUB); Kamphaeng Phet, Khlong Lan National Park, 580 m, 30 Aug. 1983, *S. Akrakisee* 18 (BCU); Loei, Phu Ruea, 18 Jul. 2006, *Sawai & K. Makomol* 11/06 (KKU); Chiang Mai, Chiang Dao Wildlife Sanctuary, Khao Kang Hau, 11 Aug. 1963, *Sinchai* 9 (BKF, K, L); Prachuap Khiri Khan, Huai Yang Waterfall National Park, 11° 38' 21.8" N 99° 35' 40.4" E, 748 m, 4 Aug. 2014, *Sirisak W.* 060 (BCU); *ibid.*, 11° 38' 23.6" N 99° 35' 39.5" E, 759 m, 4 Aug. 2014, *Sirisak W.* 061 (BCU); *ibid.*, 11° 38' 24" N 99° 35' 39.3" E, 760 m, 4 Aug. 2014, *Sirisak W.* 062 (BCU); *ibid.*, 11° 38' 24" N 99° 35' 39.6" E, 767 m, 4 Aug. 2014, *Sirisak W.* 063 (BCU); Chaiyaphum, Phu Khiao Wildlife Sanctuary, 830 m, 28 Jul. 2001, *S. Pimpa* 29 (BCU); Chiang Rai, 21 Jan. 1970, *S. Sutisorn* 1533 (BK); Ratchaburi, Suan Phueng, 15 Jul. 2006, *Suan Phueng Trip* 59 (BCU); *ibid.*, *Suan Phueng Trip* 61 (BCU); Ratchaburi, Suan Phueng, Khao Kra Jom, 26 Aug. 2006, *Suan Phueng Trip* 154 (BCU); Chiang Mai, Mae Rim, Queen Sirikit Botanical Garden, Huai Heai, c 800 m, 30 Apr. 1994, *S. Watthana* s.n. (QBG); Loei, Phu

Kradueng, Phu Kradueng National Park, 900–1,200 m, 14 Nov. 1979, *T. Shimizu, H. Toyokuni, H. Koyama, T. Yahara & C. Niyomdham* T-22642 (BKF); Chantaburi, Khao Soi Dao Wildlife Sanctuary, 800–850 m, 26 Nov. 1979, *T. Shimizu, H. Toyokuni, H. Koyama, T. Yahara & D. Phanichaphol* T-23678 (BKF, L); Chaiyaphum, Nam Phrom Dam, 950 m, 13 Aug. 1977, *T. Boonkerd* 60 (BCU); Nakhon Ratchasima, Sakaerat Environmental Research Station, 350 m, 30 Sep. 1974, *T. Boonkerd* 219 (BCU); *ibid.*, *T. Boonkerd* 220 (BCU); Nakhon Ratchasima, Sakaerat Environmental Research Station, 400 m, 1 Oct. 1974, *T. Boonkerd* 263 (BCU); *ibid.*, *T. Boonkerd* 264 (BCU); *ibid.*, *T. Boonkerd* 265 (BCU); Chaiyaphum, Nam Phrom Dam, 900 m, 31 Aug. 1977, *T. Boonkerd* 460 (BCU); Yala, Betong, Dao Dueng Waterfalls, 800 m, 24 May 1993, *T. Boonkerd* 1163 (BCU); Chumphon, Phato, Khao Khiew, 500 m, 10 Apr. 1995, *T. Boonkerd* 1527 (BCU); Kanchanaburi, Khao Nan Ya, 800 m, 11 May 2011, *T. Boonkerd et al.* 2011-121 (BCU); Chiang Mai, Chiang Dao Wildlife Sanctuary, Huai Pha Tang-Na Lao, Pa Sob Protected Unit, 1,050 m, 25 Jul. 2012, *T. Boonkerd et al.* 2011-643 (BCU); Nakhon Si Thammarat, Khao Nan National Park, Huai Lhek, 7 Apr. 2006, *T. Boonkerd, S. Chantanaorrapint & W. Khwaiphan* 59 (BCU); *ibid.*, 8 Jul. 2006, *T. Boonkerd, S. Chantanaorrapint & W. Khwaiphan* 76 (BCU); Chantaburi, Khao Soi Dao Wildlife Sanctuary, 150 m, 4 Dec. 1988, *T. Seelanan* 10 (BCU); Loei, Phu Kradueng National Park, 800–1,100 m, 9 Mar. 1967, *T. Shimizu, M. Hutoh & D. Chaiglom* T-8812 (BKF); Tak, Mae Sot, Muser Village, 800–900 m, 24 Jul. 1959, *T. Smitinand* 6048 (BKF, K); Tak, Doi Muser, c 900 m, 6 Dec. 1960, *T. Smitinand* 7014 (BKF); Thung Yai Naresuan Wildlife Sanctuary, 550 m, 28 Feb. 1993, *T. Smitinand and T. Santisuk et al.* 507 (BKF); Tak, Ban Muser, c 400 m, 24 Jul. 1959, *T. Sørensen, K. Larsen, and B. Hansen* 7699 (BKF); Kanchanaburi, Sai Yok, Tao Dam Forest, 350–600 m, 11 Aug. 2001, *T. Vongthavone* 083 (BK, BKF); Prachuap Khiri Khan, Hua Hin, 356 m, 14 Jul. 2008, *V. Chamchumroon* V.C.2676 (BKF); *ibid.*, *V. Chamchumroon* V.C.2678 (BKF); Phetchabun, Nam Nao National Park, Huai Dong Bag, 11 Oct. 2012, *W. Balee, K. Makgomol* 960 (KKU); Nan, Song Khwae, Yod, Tham Sakoen National Park, 19° 23' 19.0" N 100° 31' 92.6" E, 767 m, 15 Dec. 2010, *W. La-onsri & N. Romkham* 1230 (QBG); *ibid.*, 19° 24' 11.8" N 100° 31' 95.6" E, 141 m, 11 Feb. 2011, *W. La-onsri & N. Romkham* 1429 (PSU, QBG); Loei, Na Haeo, c 1,200 m, 25 Apr. 1994, *W. Nanakorn et al.* 3145 (QBG); Chiang Mai, Mae Rim, Queen Sirikit Botanical Garden, 700 m, 22 Jun. 1995, *W. Nanakorn et al.* 3715 (QBG); Loei, Na Haeo, c 700 m, 21 Jun. 1995, *W. Nanakorn et al.* 3874 (QBG); Loei, Na Haeo, Huai Nam Phek, 9 Dec. 1996, *W. Nanakorn et al.* 8044 (QBG); Lampang, 400 m, 20 Feb. 1922, *Winit* 32-901 (BKF); *ibid.*, 900 m, 22 Feb. 1922, *Winit* 34-903 (BKF), Prachuap Khiri Khan, Huai Yang Waterfall National Park, 800 m, 25 Apr. 2000, *Y. Yuyen* 31 (BCU);

**CHINA:** *Yunnan*, *J.F. Rock* 2637 (BM), *H.* 5728 (BM), *R.C. Ching* 595 (PE), *Yunnan Complex Exped.* 5891 (PE); **INDIA:** **Andaman Islands**, *Dr. King's Collector* 471 (P), *N. Bhargawa, H.P. Nooteboom, K.U. Kramer & G.B. Nair* no. BSI (A & N C.) 6349 (K), *N.P. Balakrishnan, H.P. Nooteboom, K.U. Kramer & G.B. Nair* no. BSI (A & N C.) 6476 (K, L), **MALESIA:** **Peninsular Malaysia**, *B. Molesworth-Allen* 4454 (A, K), *B. Molesworth-Allen* 4948 (K), *P. J. Edwards* 3667 (L); **Borneo**, *C.W. Chen* Wade4195 (TAIF); **MYANMAR:** *Brandis* 218 (K), *J.H. Lace* 4855 (K), *Parish* 145 (K), *Philippe L. de Vilmorin* 24 (P); **CAMBODIA:** *L. Bouillod* 31 (P); **VIETNAM:** *C.G. Matthew* 33 (K), *C.W. Chen* Wade1421 (TAIF).



**18. *Tectaria hymenophylla*** (Parish ex Bedd.) Holttum, Indian Fern J. 1(1–2): 35. 1984; Kew Bull. 43(3): 477. 1988. Type: Myanmar, near Moulmein, C.S. Parish s.n. [holotype K! (K001080686), isotypes K! (K001080687, K001080688, K001080689), P! (photo seen P00630809, P00630810)].

*Acrophorus hymenophyllus* Parish ex Bedd., Ferns Brit. India 1: 96, t. 96. 1866. Type: as for above.

*Rhizome* not seen. *Fronde* monomorphic, lamina tripinnatifid at base, bipinnatifid upwards; stipes stramineous to pale brown, grooved, 10.5–12.0 cm long, covered with short hairs throughout; lamina ovate-subdeltoid, 10.0–12.0 × 8.0–10.0 cm; basal pinnae 4.5–5.5 × 3.0–4.0 cm, stalked, stalk 0.3–0.5 cm long, ovate-subdeltoid, deeply lobed; basal basiscopic pinnules 2.0–2.5 × 1.0–1.5 cm, elliptic, apex acute, margin deeply lobed to 4/5 towards costule, lobes lanceolate-oblong, apex acute, margin crenate to lobed; basal acroscopic pinnules 1.0–1.5 × 0.5–1.0 cm, ovate, apex acute, margin deeply lobed to 4/5 towards costule, lobes lanceolate-oblong, apex acute, margin entire; terminal pinnule 4–5 × 2.5–3 cm, asymmetric, ovate, apex acuminate, base cuneate, margin deeply lobed to 4/5 towards costule, lobes lanceolate-oblong, apex acute, margin crenate to lobed; lateral pinnae 2–3 pairs, upper pinnae gradually becoming smaller, alternate to subopposite, sessile, 2.0–3.5 × 1.0–1.5 cm, elliptic-oblong, apex acuminate, base cuneate or fused with costae, margin deeply lobed to 4/5 towards costae, lobes lanceolate-oblong, apex acute, margin crenate to lobed, interval 1.0–1.5 cm; terminal pinna 3.0–3.5 × 1.5–2.0 cm, ovate-lanceolate, apex acuminate, margin deeply lobed to 1/2 towards costa, lobes lanceolate-oblong, apex acute, margin entire; herbaceous, pubescent on both surface, covering with short white hairs throughout, very few thick hairs between veins on upper surface densely hairy on costae, costules and midrib, veins all free, simple or forked. *Sori* round, terminal on veinlets, usually near apices of lobes, arranged in two rows between main veins; indusia round-reniform, thin. **Fig. 4.18.**

Thailand.— SOUTH-WESTERN: Kanchanaburi (Thung Kang Yang Hills).

Distribution.— Myanmar (type).

Ecology.— Evergreen forest at 350 m alt.

Note.— Similar to *Tectaria manilensis* (C. Presl) Holttum but differing in its frond surface and sori distribution. Thai specimen was so young, further fieldworks need to be investigated.

Specimens examined.— **THAILAND:** Kanchanaburi, Thung Kang Yang Hills, 350 m, 7 Mar. 1963, K. Larsen 10459 (BKF);

**MYANMAR:** C.R. Fraser-Jenkins 32150 (TAIF), C.S. Parish s.n. (K, P).

**19. *Tectaria impressa*** (Fée) Holttum, Kew Bull. 43: 483. 1988; Tagawa & K. Iwats., Fl. Thailand 3(4): 621. 1989; Holttum, Fl. Males., Ser. 2, Pterid. 2: 51. 1991; I.M. Turner, Gard. Bull. Singapore 47(1): 54. 1995; Boonkerd & Pollawatn, Pterid. Thailand: 162, 163, 218. 2000; S.K. Wu, Acta Phytotax. Sin. 40(6): 537. 2002; Newman et al., Checkl. Vasc. Pl. Lao PDR: 32. 2007. S. Linds., D.J. Middleton, Boonkerd & Suddee, Thai For. Bull., Bot. 37: 97. 2009; F.W. Xing, Y.H. Yan, S.Y. Dong, F.G. Wang, Christenh. & Hovenkamp, Fl. China 2–3: 739. 2013. Type: Ind. Or., Griffith 34 [holotype RB! (RB00543368), photo K!].

- Phlebigoonium impressum* Fée, Gen. Fil.: 314. 1852. Type: as for above.
- Aspidium variolosum* Wall. ex Hook., Sp. Fil. 4: 51. 1862; Bedd., Handb. Ferns Brit. India: 216, f. 111. 1883; Christ, Bot. Tidsskr. 24: 108. 1901; C. Chr., Bot. Tidsskr. 32: 419. 1916. Type: Myanmar, Kyaikkami (Amherst), *Wallich* 379 [lectotype K! (K001080680), isolectotypes BM! (BM001048588), K! (K001080681, K001080682, K001080683), paralectotypes Bangladesh, *Wallich* 379 UC! (photo seen UC 267883), India, *Wallich* 379 US! (photo seen US00135279)].
- Nephrodium variolosum* (Wall. ex Hook.) Hook. & Baker, Syn. Fil.: 298. 1867; Ostenfeld, Bull. Herb. Boiss. II. 5: 721. 1905. Type: as for *A. variolosum*.
- Tectaria variolosa* (Wall. ex Hook.) C. Chr., Contr. U.S. Natl. Herb. 26: 289. 1931; Ching, Sinensia 2(2): 21, pl. 3. 1931; Tardieu & C. Chr., Fl. Indo-Chine 7(2): 412. 1941; Dickason, Ohio J. Sci. 46(3): 121. 1946; Holttum, Rev. Fl. Malaya ed. 1, 2: 506, f. 298. 1955 [‘1954’]; Dansk Bot. Ark. 20: 31. 1961; *ibid.* 23: 242. 1965; Tagawa & K. Iwats., S. E. Asian Stud. 5: 97. 1967; K. Iwats., Acta Phytotax. Geobot. 25(2–3): 71. 1972; C.E. DeVol & C.M. Kuo, Fl. Taiwan 1: 344. 1975; Tagawa & K. Iwats., Fl. Thailand 3(3): 368. 1988; J.L. Tsai & W.C. Shieh, Fl. Taiwan, ed. 2: 301. 1994; Boonkerd & Pollawatn, Pterid. Thailand: 163. 2000; S.G. Lu & T.Y.A. Yang, Taiwania 50(2): 158. 2005; Newman et al., Checkl. Vasc. Pl. Lao PDR: 32. 2007. Type: as for *A. variolosum*.
- Aspidium cordifolium* C. Presl, Epim. Bot.: 63. 1851, *nom. illeg. hom.* Type: India orientali ad Moulmine, *Helper* 16 [holotype PRC! (photo seen PRC 450249), photo BM!].
- Aspidium immersum* Hook., Sp. Fil. 4: 58. 1862 (non Blume, 1828). Type: India, *Wallich* s.n. [holotype K! (K001080685), BM! (line drawing)].
- Aspidium prominens* Alderw., Bull. Jard. Bot. Buitenzorg 2, 16: 56. 1914; Malayan Ferns, Suppl.: 198. 1917. Type: Sumatra, *Matthew* 706 [holotype BO, photo K! (K000237157, K000237158)].
- Tectaria prominens* (Alderw.) C. Chr., Index Filic. Suppl. 3: 183. 1934. Type: as for *A. prominens*.
- Aspidium zollingerianum* auct. Bedd. (non Kunze, 1846), Ferns Brit. India: t. 251. 1867.
- Sagenia membranifolia* auct. Hosseus (non Christ, 1902), Beih. Bot. Centralbl. 28(2): 366. 1911.
- Tectaria brachiata* sensu auctt. C.M. Kuo [non (Zoll. & Moritzi) Morton, 1973], Taiwania 30. 29. 1985; Newman et al., Checkl. Vasc. Pl. Lao PDR: 32. 2007.
- Rhizome* short, creeping or suberect, scaly; scales basifixed, bicolored, dark brown centrally with paler margin, 3–8 × 1–2 mm, lanceolate, apex acuminate, margin hairy. *Fronde*s dimorphic, fertile and sterile fronds similar in shape but rather smaller than sterile fronds, lamina bipinnatifid to bipinnate at base, bipinnatifid upwards; stipes stramineous to dark brown, 25.0–40.0 cm long in sterile fronds and 21.0–45.0 cm long in fertile fronds, scaly at nearly base, covered with short hairs; lamina 35.0–52.0 × 21.0–30.0 cm in sterile fronds and 12.0–13.5 × 8.0–9.0 cm long in fertile fronds, ovate-subdeltoid in outline; basal pinnae bipinnatifid when young and becoming to bipinnate when mature, 13.0–16.0 × 6.5–13.0 cm in sterile fronds and 6.5–7.5 × 3.0–4.0 cm in fertile fronds, asymmetric, stipitate, stalks 0.5–1.5 cm long in

sterile fronds and 0.5–1.0 cm long in fertile fronds, opposite, ovate in outline, margin deeply lobed; basal basiscopic pinnule or basal basiscopic lobe 4.5–10.0 × 1.0–3.0 cm in sterile fronds and 3.5–4.0 × 1.0–1.5 cm in fertile fronds, subsessile to shortly stalked, lanceolate-elliptic, sometimes falcate, apex acuminate, base round, margin subentire to shallowly lobed; apical pinnules or apical lobes 3.0–3.5 × 0.5–1.5 cm in sterile fronds and 1.0–2.0 × 0.5–1.0 cm in fertile fronds, lanceolate-elliptic, apex acute, base round, margin entire to slightly crenate; terminal pinnule 10.5–14.0 × 4.0–12.0 cm in sterile fronds and 3.0–6.5 × 3.0–4.0 cm in fertile fronds, pinnatifid, asymmetric, ovate-subdeltoid, apex acuminate, base cuneate, margin deeply lobed to 4/5 way towards costules, lobes lanceolate, apex acute, margin subentire; lateral pinnae 1–3 pairs, 11.0–12.5 × 3.0–4.0 cm in sterile fronds and 4.5–6.5 × 1.0–1.5 cm in fertile fronds, opposite, shortly stalked to subsessile upwards, opposite, lanceolate-elliptic, apex acuminate, base cordate, margin lobed to 1/2 towards costa, lobes lanceolate, apex acute, margin entire; terminal pinna 20.0–28.0 × 11.5–20.0 cm in sterile fronds and 5.0–7.0 × 3.0–4.0 cm in fertile fronds, ovate, apex acuminate, base cordate to cuneate, margin deeply lobed to 1/2 to 2/3 towards costa, lobes lanceolate, apex acute, margin entire to irregularly crenate; chartaceous, glabrous except a few hairs on sinus, midrib and main veins beneath, veins fully anastomosing to form areoles with and without free included veinlets, veinlets simple, free veinlets in costal and costular areoles absent. *Sori* round, terminal on free included veinlets in areoles, one in each areoles, arranged in two rows between main veins, usually sunken on lamina, indusia round-reniform, peltate, persistent. **Fig. 4.19.**

Thailand.— NORTHERN: Mae Hong Son (Huai Hi, Khun Yuam, San Pan Dan Wildlife Sanctuary), Chiang Mai (Chiang Dao Wildlife Sanctuary, Chiang Mai University, Chom Thong, Doi Inthanon National Park, Doi Pha Hom Pok National Park, Doi Saket, Doi Suthep-Pui National Park, Fang, San Kamphaeng, San Sai), Chiang Rai (Ban Mae Kon, Chiang Khong, Doi Hang), Phayao (Doi Huai Sa, Doi Luang National Park, Doi Pha Chang Wildlife Sanctuary), Nan (Na Noi, Tham Sakoen National Park), Lamphun (Doi Khun Tan National Park, Pa Sang), Lampang (Chae Hom, Chae Son National Park, Doi Luang National Park, Doi Pha Lad, Huai Thak, Ngao), Phrae (Mae Yom National Park, Me Ban, Song), Uttaradit (Ban Mae Choei, Tha Pla), Tak (Doi Pang Kluay, Lan Sang National Park, Mae Sot, Thung Yai Naresuan Wildlife Sanctuary), Sukhothai (Ramkamhaeng National Park), Phitsanulok (Phu Hin Rong Kla National Park, Phu Miang-Phu Thong Wildlife Sanctuary, Thong Nong Tow, Thung Salaeng Luang National Park), Kamphaeng Phet (Khao Son); NORTH-EASTERN: Phetchabun (Chon Daen, Khao Kho, Nam Nao National Park), Loei (Phu Kho-Phu Kratae Wildlife Sanctuary, Phu Kradueng National Park, Phu Luang Wildlife Sanctuary, Phu Pak Arboretum, Phu Suan Sai National Park, Wang Saphung), Nong Bua Lam Phu (Phu Hin Lat Cho Fa), Sakon Nakhon (Phu Phan National Park), Khon Kaen (Chum Phae, Pha Nok Khao, Phu Pha Man National Park); EASTERN: Chaiyaphum (Nam Phrom, Phu Khiao Wildlife Sanctuary), Ubon Ratchathani (Phu Chong-Na Yoi National Park), Nakhon Ratchasima (Khao Yai National Park, Sakaerat, Wang Nam Khiao); CENTRAL: Nakhon Nayok (Khao Yai National Park, Sarika Waterfall), Saraburi (Namtok Samlan National Park); SOUTH-EASTERN: Sa Kaeo (Ban Bung Hills, Khao Takrup, Pang Si Da National Park), Prachin Buri (Khao Yai National Park), Chonburi (Khao Khieo Open Zoo, Sattahip, Si Racha, Thung Prong), Rayong (Ban Phe, Khao Chamao-Khao Wong National

Park), Chantaburi (Khao Khitchakut National Park, Khao Sabap, Khao Soi Dao Wildlife Sanctuary, Kung Krabaen Bay, Namtok Phlio National Park.), Trat (Ko Chang, Ko Kut, Ko Mak, Ko Rang Yai); SOUTH-WESTERN: Uthai Thani (Ban Rai, Huai Kha Khaeng Wildlife Sanctuary), Kanchanaburi (Sai Yok, Thong Pha Phum, Thung Yai Naresuan Wildlife Sanctuary), Phetchaburi (Kaeng Krachan National Park), Prachuap Khiri Khan (Bang Saphan, Huai Yang Waterfall National Park); PENINSULAR: Ranong (Ko Sin Hai, Laem Son National Park, La-Un, Thap Li), Surat Thani, Phangnga (Ko Phra Thong, Ko Surin National Park, Ko Yao Noi, Ko Yao Yai), Krabi (Ko Lanta Yai), Satun (Tarutao National Park).

Distribution.— Nepal, India (type), Bangladesh (Chittagong, Dhaka), China (Yunnan, Guizhou, Guangxi, Guangdong, Hainan, Taiwan), Myanmar (Kayin, Thanlyin, Moulmein, Tavoy), Laos, Cambodia, Vietnam, Malesia (Peninsular Malaysia, Sumatra).

Ecology.— Terrestrial in shady places on dry mountain slopes in dry evergreen forest, mixed deciduous forest, and bamboo forest at sea level to 1,200 m alt.

Vernacular.— Kut kwang (กูดขวาง), kut kiao (กูดเกี้ยว), kut sang (กูดซาง), kut hok (กูดหอก), kut hom kha (กูดส้มคำ), kut ngo (กูดงอ) (Northern); kut thep kao (กูดเทพแก้ว) (South-Eastern); chon pa (โชนป่า) (Peninsular); fern bai sa ke (เฟิร์นใบสาเก).

Uses.— Medicinal plant of Yao tribe for curing some fever by using rhizome (ทวิศักดิ์ บุญเกิด, 2524). In addition, it has been an ornamental plant for fern lovers.

Note.— Very similar to *Tectaria brachiata* (Zoll. & Moritzi) C.V. Morton in appearance but differing in its venation as note of Holttum (1985). Based on Thai specimens, I agree with Holttum's study.

Specimens examined.— **THAILAND:** Chiang Mai, Doi Suthep-Pui National Park, 1,100 m, 30 Jul. 1911, *A.F.G. Kerr* 1939 (K); Loei, Wang Saphung, c 200 m, 18 Mar. 1924, *A.F.G. Kerr* 8777 (BK, K); Ranong, La-un, c 50 m, 31 Dec. 1928, *A.F.G. Kerr* 16471 (BK); Kanchanaburi, Sai Yok, c 350 m, 3 Aug. 1928, *A. Marcan* 3401 (K); Chiang Mai, Mueang Chiang Mai, Doi Suthep-Pui National Park, 700 m, 2 Apr. 1993, *A. Phuakam* 7 (CMUB, L); Kanchanaburi, Thong Pha Phum, 900–1,000 m, 22 Jul. 2002, *A. Sathapattayanon* 58 (BCU); *ibid.*, 23 Jul. 2002, *A. Sathapattayanon* 288 (BCU); *ibid.*, 24 Jul. 2002, *A. Sathapattayanon* 299 (BCU); *ibid.*, 25 Jul. 2002, *A. Sathapattayanon* 310 (BCU); Chaiyaphum, Phu Khiao Wildlife Sanctuary, *A. Sathapattayanon* 558 (BCU); *ibid.*, *A. Sathapattayanon* 618 (BCU); *ibid.*, *A. Sathapattayanon* 765 (BCU); *ibid.*, *A. Sathapattayanon* 793 (BCU); Lampang, Ngao, Huai Tao, 360 m, 2 May 1954, *B. Sangkhachand* 26 (BKF); Tak, Bhumibol Dam, Ban Na, 750 m, May 1959, *Boonnag* 631 (BCU, BK); Chonburi, Sattahip, Toong Brong, 50 m, 28 Mar. 1971, *B. Watdahnahsahp* 190 (L); Trang, Kantang, Ko Rok Noi, 5 Nov. 1919, *C.B. Kloss, H.C. Robinson* 6352 (K); Ranong, Thap Li, 5 Nov. 1919, *C.B. Kloss, H.C. Robinson* 6735 (K); Chiang Mai, Doi Suthep-Pui National Park, 900 m, 21 Apr. 1966, *C. Cheunsirivathana* 570 (BK); Nakhon Ratchasima, Khao Yai National Park, 13 Oct. 1904, *C.C. Hosseus* 90 (BM, K, L); Satun, Tarutao Island, 30 Jul. 1980, *C. Congdon* 791 (PSU); Nakhon Ratchasima, Sakaerat Environmental Research Station, c 400 m, 28 Oct. 1969, *C.F. van Beusekom, C. Charoenpol* 1874 (L); Nakhon Ratchasima, Khao Yai National Park, c 14° 25' N, 102° E, 500–600 m, 31 Oct. 1969, *C.F. van Beusekom, C. Charoenpol* 1945 (BKF, K, L); Nakhon Ratchasima, 14° 40' N, 102° 2' E, 400 m, 22 Oct. 1971, *C.F. van Beusekom, C. Wid*,

*R. Geesink* 3271 (BKF, L); Chiang Mai, Fang, c 20° N, 99° 20' E, c 550 m, 21 Dec. 1969, *C.F. van Beusekom, C. Phengklai* 2656 (BKF, K, L); Chaiyaphum, Nam Phrom, 600 m, 11 Dec. 1971, *C.F. van Beusekom, C. Phengklai, R. Geesink, B. Wongwan* 4156 (BKF, L); *ibid.*, 20 Dec. 1971, *C.F. van Beusekom, C. Phengklai, R. Geesink, B. Wongwan* 4450 (BKF, L); Chiang Mai, Mae Rim, Queen Sirikit Botanical Garden, 18 Jun. 2002, *C. Glamwaewwong* 206 (E, QBG); Trat, Ko Rang Yai, 11° 48' N, 102° 23' E, 19 Nov. 1970, *Ch. Charoenphol, Kai Larsen & E. Warncke* 5021 (BKF, K, L); Trat, Ko Chang, 9 Apr. 1992, *C. Niyomdham* 3202 (BKF); Lampang, Ngao, 850 m, *C. Niyomdham* 6515 (BKF); Kanchanaburi, Mae Nam Kwae Noi, 21 Dec. 1961, *C. Phengklai* 293 (BKF); Krabi, Ko Lanta Yai, 0–50 m, 22 Nov. 2002, *C. Phengklai* 14824 (BKF); Rayong, c 100–120 m, 25 Aug. 1977, *C. Phengklai et al.* 3861 (BKF); Kamphaeng Phet, Khao Son, Ban Nam Tok, 200 m, 24 Nov. 1977, *C. Phengklai et al.* 3905 (BKF); Chaiyaphum, Phu Khiao Wildlife Sanctuary, Oct. 1999, *C. Phengklai et al.* 12266 (BKF); Chon Buri, Khao Kheow Open Zoo, c 300 m, 8 Jul. 2000, *C. Phengklai et al.* 12593 (BKF); *ibid.*, 9 Sep. 2000, *C. Phengklai et al.* 12681 (BKF); *ibid.*, 14 Aug. 2000, *C. Phengklai et al.* 12741 (BKF); *ibid.*, 10 Dec. 2000, *C. Phengklai et al.* 12845 (BKF); Trat, Ko Kut, 0–80 m, 21 Oct. 2000, *C. Phengklai et al.* 12967 (BKF); *ibid.*, *C. Phengklai et al.* 13001 (BKF); *ibid.*, 10–80 m, 7 Apr. 2002, *C. Phengklai et al.* 13349 (BKF); *ibid.*, Ao Salad, 0–80 m, 9 Apr. 2002, *C. Phengklai et al.* 13568 (BKF); Trat, Ko Chang, c 70 m, 5 Mar. 2003, *C. Phengklai et al.* 14138 (BKF); Phangnga, Khura Buri, Ko Phra Thong, 0–50 m, 5 Apr. 2004, *C. Phengklai et al.* 14300 (BKF); Trat, Ko Mak, 0–50 m, 6 Mar. 2003, *C. Phengklai et al.* 14552 (BKF); Phangnga, Ko Yao Yai, 0–90 m, 30 Apr. 2007, *C. Phengklai et al.* 15535 (BKF); Phangnga, Ko Yao Noi, 0–50 m, 2 May 2007, *C. Phengklai et al.* 15593 (BKF); *ibid.*, *C. Phengklai et al.* 15596 (BCU, BKF); Phangnga, Ko Surin National Park, 0–50 m, 5 Sep. 2012, *C. Phengklai et al.* 16290 (BKF); Chiang Mai, Doi Inthanon National Park, Mae Ya Waterfalls, c 400 m, 15 Dec. 1998, *C. Phengklai, F. Konta & S. Khao-iam* 11238 (BKF); Phrae, Long, Mae Pan, 15 Sep. 1929, *C.W. Franck* s.n. (L); Nakhon Ratchasima, Wang Nak Khiao, 13 Dec. 1967, *Damrongsak* 479 (BKF); *ibid.*, 19 Jul. 1968, *Damrongsak* s.n. (BKF); Phetchaburi, Amphoe Kaeng Krachan: Kaeng Krachan National Park. Trail from near Khao Phanoen Thung Ranger substation towards KU Camp on Phetchaburi River. 600 m, 27 Mar. 2003, *D.J. Middleton, C. Hemrat, S. Lindsay, S. Suddee & S. Suwanachat* 1731 (BKF); *ibid.*, Trail from Khao Phanoen Thung Ranger Substation to Thor Thip waterfall, 540 m, 11 Dec. 2002, *D.J. Middleton, S. Suddee & C. Hemrat* 1561 (BKF); *ibid.*, Trail from Ban Krang Ranger Substation, 12° 48' N, 99° 26' E, *D.J. Middleton, S. Suddee, S.J. Davies & C. Hemrat* 942 (BKF, E); Loei, Phu Kradueng National Park, 6 Aug. 1952, *Dee* 568 (BKF); Sa Kaeo, Khao Takrup, On trail up mountain from Centennial Botanic Garden, 13° 26' N, 101° 57' E, 9 Sep. 1999, *D.J. Middleton* 175 (BKF); Trat, Ko Chang, Thammagon Waterfalls, Trail from Ranger substation to waterfall, 145 m, 5 Jan. 2009, *D.J. Middleton, P. Karaket, S. Lindsay, T. Phutthai and S. Suddee* 4605 (BKF, E); Tak, Lan Sang National Park, 16° 50' N, 99° 5' E, c 400 m, 18 Nov. 1965, *E. Hennipman* 3021 (B, BKF, L); Chiang Mai, Doi Suthep-Pui National Park, 18° 50' N, 98° 55' E, c 1,050 m, 29 Nov. 1965, *E. Hennipman* 3127 (B, BKF, L); Chiang Mai, Fang, 19° 55' N, 99° 10' E, c 600 m, 9 Dec. 1965, *E. Hennipman* 3322 (BKF, K, L); Loei, Phung Luang Wildlife Sanctuary, 3 km from Ban Na Luang, 17° 25' N, 101° 25' E, c 370 m, 1 Jun. 1966, *E. Hennipman* 3518 (BKF, L); Nakhon Nayok,

Sarika Waterfalls, c 150 m, 2 Jul. 1966, *E. Hennipman* 3964 (BKF, L); Tak, 9 Jan. 1904, *E. Lindhard* 46 (K); Chiang Mai, Chiang Dao Wildlife Sanctuary, Oct.-Nov. 1922, *E. Smith* 1176 (BKF, K); Tak, c 150 m, Jun. 1924, *E. Smith* 2713 (K); *ibid.*, *E. Smith* 2715 (BM, K); *ibid.*, *E. Smith* 2718 (K); Chiang Mai, Chom Thong, Doi Inthanon National Park, Mae Ya Waterfalls, 600 m, 15 Dec. 1998, *F. Konta*, *C. Phengklai*, and *S. Khao-Iam* 4522 (BKF); Prachin Buri, Khao Yai National Park, 14° 20' N, 101° 49' E, c 290–350 m, 2 Oct. 1984, *G. Murata*, *C. Phengklai*, *S. Mitsuta*, *H. Nagamasu* & *N. Nantasan* T-s.n. (QBG); Phitsanulok, Thung Salaeng Luang National Park, 16° 49' N 100° 36–38' E, 450–480 m, 21 Oct. 1984, *G. Murata*, *C. Phengklai*, *S. Mitsuta*, *T. Yahara*, *H. Nagamasu* & *N. Nantasan* T-38257 (BKF, L); *ibid.*, *G. Murata*, *C. Phengklai*, *S. Mitsuta*, *T. Yahara*, *H. Nagamasu* & *N. Nantasan* T-38307 (BKF); Phitsanulok, Thung Salaeng Luang National Park, Tan Ta Wang Village, c 680–730 m, 22 Oct. 1984, *G. Murata*, *C. Phengklai*, *S. Mitsuta*, *T. Yahara*, *H. Nagamasu* & *N. Nantasan* T-38626 (BKF); *ibid.*, *G. Murata*, *C. Phengklai*, *S. Mitsuta*, *T. Yahara*, *H. Nagamasu* & *N. Nantasan* T-38667 (BKF); Chaiyaphum, Phu Khiao Wildlife Sanctuary, 16° 28' N 101° 45' E, 850–900 m, 7 Nov. 1984, *G. Murata*, *C. Phengklai*, *S. Mitsuta*, *T. Yahara*, *H. Nagamasu* & *N. Nantasan* T-49570 (BKF); Sakon Nakhon, Phu Phan National Park, c 17° N 104° E, 12 Nov. 1984, *G. Murata*, *C. Phengklai*, *S. Mitsuta*, *T. Yahara*, *H. Nagamasu* & *N. Nantasan* T-51305 (BKF); Phetchabun, Nam Nao National Park, 16° 48–49' N 101° 23–28' E, c 850 m, 28 Oct. 1984, *G. Murata*, *C. Phengklai*, *S. Mitsuta*, *T. Yahara*, *H. Nagamasu* & *N. Nantasan* T-51670 (BKF); Trat, Ko Chang, near sea level, 8 Feb. 1973, *G. Murata*, *N. Fukuoka* & *C. Phengklai* T-17486 (BKF, E, K, L, QBG); *ibid.*, *G. Murata*, *N. Fukuoka* & *C. Phengklai* T-17487 (BKF, K, L, QBG); Chiang Rai, Doi Hang, 5 Jan. 1925, *H. B. G. Garrett* 216 (BCU, BKF, K); Lampang, Mae Tha, Doi Khun Tan National Park, 700–800 m, 28 Dec. 1984, *H. Koyama* & *C. Phengklai* T-39159 (BKF); *ibid.*, *H. Koyama* & *C. Phengklai* T-39181 (BKF); Chiang Mai, Fang, 640 m, 10 Feb. 1983, *H. Koyama*, *H. Terao* & *T. Wongprasert* T-33317 (BKF); Chantaburi, 12° 35' N, 102° 8' E, Jul. 1882, *H.J. Murton* 104 (K); Sa Kaeo, Khao Takrup, 11 Aug. 1999, *I. Schanzer* N 59b (BCU); Kanchaburi, Thong Pha Phum, Huai Ka Yeng, Pu Nong Pling, 200 m, 29 Jan. 2005, *J. Chunthawodtiporn* 3 (BCU); Chiang Rai, San Sai, 400 m, 15 Jun 2003, *J.F. Maxwell* 03-136 (BKF, CMUB, L); Lamphun, Pa Sang, Pha Daeng, 575 m, 14 Oct. 2004, *J.F. Maxwell* 04-596 (CMUB, L); Ranong, Kaper, Laem Son National Park, 5 m, 1 Dec. 1996, *J.F. Maxwell* 96-1589 (CMUB, L); Phrae, Song, Mae Yom, 500 m, 11 Jun. 2006, *J.F. Maxwell* 06-383 (CMUB, L, QBG); Lampang, Chae Hom, Doi Pra Ba, 350 m, 9 Nov. 2008, *J.F. Maxwell* 08-209 (CMUB, QBG); Chon Buri, Sathahip, Toong Brong, 50 m, 28 Mar. 1971, *J.F. Maxwell* 71-190 (BK); Saraburi, Mueang Saraburi, Namtok Samlan National Park, 200 m, 28 Oct. 1973, *J.F. Maxwell* 73-570 (BK); Chiang Mai, Mueang Chiang Mai, Doi Suthep-Pui National Park, 700 m, 25 Jul. 1987, *J.F. Maxwell* 87-738 (BKF, CMU, L); Chiang Mai, San Kamphaeng, Muang Awn Cave, 450 m, 29 Jul. 1989, *J.F. Maxwell* 89-962 (CMU, E, L); Chiang Mai, Doi Saket, Pa Miang, Mae Wan Village, 500 m, 27 Dec. 1989, *J.F. Maxwell* 89-1606 (CMU, E, L); Chiang Mai, Chom Thong, Mae Soi, near Huai Mae Soi, 650 m, 22 Jul. 1990, *J.F. Maxwell* 90-798 (CMU, L); Phrae, Song, Mae Yom, 225 m, 12 Dec. 1991, *J.F. Maxwell* 91-890 (L); Kanchanaburi, Sangkhla Buri, Thung Yai Naresuan Wildlife Sanctuary, Lai Wo, Ban Saneh Pawng, 200 m, 13 Aug. 1993, *J.F. Maxwell* 93-895 (BKF, CMUB, L);

Lamphun, Mae Tha, Doi Khun Tan National Park, 850 m, 23 Oct. 1993, *J.F. Maxwell* 93-1278 (BKF, CMUB, L); Tak, Mae Sot, Phawo, Mu Kee Haw Village, 225 m, 18 Aug. 1994, *J.F. Maxwell* 94-884 (BKF, CMUB, L); Rayong, Khao Chamao-Khao Wong National Park, 225 m, 8 Nov. 1994, *J.F. Maxwell* 94-1195 (BKF, CMUB, L); Sukhothai, Khirimat, Ramkhamhaeng National Park, 300 m, 27 Jan. 1995, *J.F. Maxwell* 95-15 (BKF, CMUB, L); Lampang, Mueang Pan, Chae Son National Park, 525 m, 22 Aug 1995, *J.F. Maxwell* 95-530 (BKF, CMUB, L); Lampang, Wang Nuea, Doi Luang National Park, 675 m, 5 Sep. 1997, *J.F. Maxwell* 97-936 (BKF, CMUB, L); Phayao, Pong, Doi Pha Chang Wildlife Sanctuary, 950–1,000 m, 1 Aug. 1998, *J.F. Maxwell* 98-754 (BKF, CMUB, L); Mae Hong Son, Pang Mapha, San Ban Dan National Park, 400 m, 5 Aug. 1999, *J.F. Maxwell* 99-88 (BKF, CMUB, L); Chantaburi, Lam Sing, Namtok Phlio National Park, 27 Jul. 1969, *J.F. Maxwell* s.n. (BK, L); Phetchabun, Nam Nao National Park, 750 m, 12 Dec. 2003, *J. Thangthong*, *K. Makgomol* 482 (KKU); *ibid.*, *J. Thangthong*, *K. Makgomol* 483 (KKU); *ibid.*, *J. Thangthong*, *K. Makgomol* 484 (KKU); *ibid.*, *J. Thangthong*, *K. Makgomol* 485 (KKU); *ibid.*, *J. Thangthong*, *K. Makgomol* 486 (KKU); Uthai Thani, Ban Rai, Huai Hang, 27 Apr. 1963, *Kasem* 334 (BK); Chiang Mai, Fang, Ban Mae Tha Lop, 19 Aug. 1967, *K. Bunchuai* 1512 (BKF, L); Chanthaburi, Kung Krabaen Bay, Feb. 1991, *K. Chayamarit* 43 (BKF); Phetchabun, Nam Nao National Park, Sam Ma Kao, 17 Oct. 2007, *Kittima*, *Jiranan* KM 792 (KKU); *ibid.*, Tham Huai Pra Lad Ranger Station, 19 Oct. 2007, *Kittima*, *Katchareya* KM 823 (KKU); *ibid.*, Huai Heaw, 18 Oct. 2007, *Kittima*, *Kobkaew* KM 809 (KKU); *ibid.*, Pak Tok, 18 Oct. 2006, *Kittima*, *Natthaporn* KM 731 (KKU); *ibid.*, *Kittima*, *Natthaporn* KM 732 (KKU); *ibid.*, *Kittima*, *Natthaporn* KM 733 (KKU); *ibid.*, Heaw Sai Waterfalls, 20 May 2005, *Kittima*, *Nucharee* 622 (KKU); *ibid.*, Sai Thong Waterfalls, 20 Oct. 2005, *Kittima*, *Nucharee* 623 (KKU); *ibid.*, *Kittima*, *Nucharee* 624 (KKU); *ibid.*, Phrom Laeng, 21 May 2005, *Kittima*, *Thansuda* KM 551 (KKU); *ibid.*, Sam Ma Kao, 10 Oct. 2008, *Kittima*, *Tichakorn* KM 839 (KKU); Sakon Nakhon, Phu Phan National Park, Kham Hom Waterfalls, 12 Oct. 1995, *K. Makgomol* 0374 (KKU); *ibid.*, *K. Makgomol* 0375 (KKU); *ibid.*, 27 Nov. 1995, *K. Makgomol* 0397 (KKU); *ibid.*, *K. Makgomol* 0398 (KKU); *ibid.*, *K. Makgomol* 0399 (KKU); Kanchanaburi, Sai Yok, 250 m, 14 Dec. 1961, *K. Larsen* 8714 (K); Chanthaburi, Khao Soi Dao Wildlife Sanctuary, 250 m, 6 Jun. 1963, *K. Larsen* 9797 (BKF, K); Chiang Mai, Fang, 600 m, 27 Feb. 1958, *K. Larsen*, and *B. Hansen* 1722 (E); Mae Hong Son, Khun Yuam, 18° 15' N, 98° E, 600–700 m, 6 Sep. 1974, *K. Larsen* & *S.S. Larsen* 34202 (K, L); Nan, Na Noi, Khun Mo Tom, km 14–16 on highway 1083, 18° 20' N, 100° 50' E, 500–700 m, 9 Dec. 1995, *K. Larsen*, *S.S. Larsen*, *C. Tange* & *D. Sookchaloem* 46405 (BKF); Rayong, Khao Chamao-Khao Wong National Park, 12° 57' N, 101° 46' E, 100–300 m, 5 Sep. 1972, *K. Larsen*, *S.S. Larsen*, *I. Nielsen* & *T. Santisuk* 32455 (BKF); Phitsanulok, Thung Salaeng Luang National Park, 600 m, 19 Jul. 1966, *K. Larsen*, *T. Smitinand* & *E. Warncke* 479 (BKF); Prachin Buri, Ban Bung Hills, 50 m, 8 Feb. 1966, *K. Larsen*, *T. Smitinand* & *E. Warncke* 1149 (BKF); Surat Thani, 15 km north of Chumphon, 75 m, 11 Aug. 1966, *K. Larsen*, *T. Smitinand* & *E. Warncke* 1450 (BKF, L); Chanthaburi, Makhom, rubber plantation, 22 Aug. 1966, *K. Larsen*, *T. Smitinand* & *E. Warncke* 1743 (BKF); Chiang Mai, 8 km N of Doi Saket towards Wieng Pa Pao, 18° 56' N, 99° 15' E, 400 m, 14 Jul. 1968, *K. Larsen*, *T. Santisuk* & *E. Warncke* 2433 (BKF, K, L); Phitsanulok, Phu Hin Rong Kla National Park, 21 Jan. 2014, *K.*

*Punchay* 7 (BCU); Lampang, Mueang Pan, Chae Son National Park, 550 m, 20 Oct. 1995, *L. M. Bañoc* 11 (CMUB, L); Chiang Mai, Chiang Dao, Ban Mae Kon, 18 Feb. 1966, *M. Matsuoka* 39 (BKF); Chiang Mai, Chiang Dao, between Ban Mae Chia and Ban Mae Kon, 28 Dec. 1961, *M. Matsuoka* 133 (BKF); Loei, Phu Kho-Phu Kratae Wildlife Sanctuary, 348 m, 25 Dec. 2011, *M. Norsaengsri & N. Tathana* 8433 (QBG); Uttaradit, Mueang Uttaradit, Ban Mae Choei, 151 m, 28 Jun 2012, *M. Norsaengsri & N. Tathana* 9625 (QBG); Uttaradit, Tha Pla, Sirikit Dam, 178 m, 29 Jun. 2012, *M. Norsaengsri & N. Tathana* 9683 (QBG); Khonkaen, Phu Pha Man National Park, 28 Feb. 2011, *M. Norsaengsri, N. Tathana, C. Lakoet* 7731 (QBG); Lampang, Chae Hom, 300 m, 6 Aug. 2000, *M. Panatkool* 379 (CMUB); Phitsanulok, Thung Salaeng Luang National Park, 500 m, 3 Oct. 1967, *M. Tagawa* T-11791 (BKF, K, L); *ibid.*, c 300–600 m, 12 Dec. 1965, *M. Tagawa & N. Fukuoka* T-2099 (BKF, L); Loei, Phu Nok Khao, c 300 m, 26 Nov. 1965, *M. Tagawa, K. Iwatsuki & N. Fukuoka* T-306 (BKF, K, L); Loei, Phu Luang Wildlife Sanctuary, from Ban Na Luang to north ridge, c 900 m, 3 Dec. 1965, *M. Tagawa, K. Iwatsuki & N. Fukuoka* T-1087 (BKF, L); *ibid.*, interior of Nam Thop, 400–850 m, 12 Jul. 1965, *M. Tagawa, K. Iwatsuki & N. Fukuoka* T-1897 (BKF, L); Tak, Lan Sang National Park, 250–500 m, 1 Sep. 1967, *M. Tagawa, K. Iwatsuki, H. Koyama & A. Chintayungkun* T-8651 (BKF, E, L, K); Lamphun, on route from Bann Khun Tan to Doi Khun Tan, c 900 m, 4 Sep. 1967, *M. Tagawa, K. Iwatsuki, H. Koyama, N. Fukuoka, A. Nalampoon & A. Chintayungkun* T-9244 (BKF, L); Chiang Mai, Chiang Dao Wildlife Sanctuary, 500–600 m, 11 Sep. 1967, *M. Tagawa, T. Shimizu, M. Hutoh, H. Koyama & A. Nalampoon* T-9750 (BKF, K, L); Phetchabun, Khao Kho, Kaeng Ratchapruak, *Nachol* T. 38 (BCU); Chiang Mai, Doi Suthep-Pui National Park, 700 m, 25 Nov. 1998, *N. Jitlam* 3 (CMUB, L); Ranong, Lamnam Kra Buri National Park, Punyaban Waterfalls, 8 Sep. 1984, *N. Fukuoka, T. Santisuk & W. Na Nakhon* T-35995 (BKF); Phetchabun, Nam Nao National Park, Huai Pairai, 25 Oct. 2013, *N. Thaweenan and K. Makgomol* KM 995 (KKU); Prachuap Khiri Khan, Pala-U, 5 Jan. 2003, *O. Neamsuvan* 57 (BCU); Phayao, Mueang Phayao, Doi Luang National Park, Champa Thong Waterfalls, 620 m, 25 Jul. 1997, *O. Petrmitr* 44 (BKF, CMUB, L); Saraburi, Mueang Saraburi, Namtok Samlan National Park, 10 m, 23 Oct. 2004, *O. Petrmitr* 574 (CMUB); Sa Kaeo, Pang Sida National Park, 4 Jul. 2001, *O. Wannasri* 13 (BCU); *ibid.*, 8 Jun. 2001, *O. Wannasri* 32 (BCU); *ibid.*, *O. Wannasri* 40 (BCU); *ibid.*, *O. Wannasri* s.n. (BCU); Sakon Nakhon, Phu Phan National Park, Kaen Mod Daeng, 17° N, 104° 2' E, 250 m, 25 Feb. 1993, *P. Chantaranonthai, D. Middleton, J. Parnell & D. Simpson* 916 (K, KKU); Sakon Nakhon, Phu Phan National Park, *P. Chantaranonthai et al.* 67 (KKU); *ibid.*, *P. Chantaranonthai et al.* 90 (KKU); *ibid.*, *P. Chantaranonthai et al.* 609 (KKU); Phitsanulok, Thung Salaeng Luang National Park, Park HQ-Sapan Saling track, 18 Sep. 1990, *P. Chantaranonthai, J. Parnell, & D. Simpson* 90/320 (K, KKU); Loei, Phu Luang Wildlife Sanctuary, Nam Tok to Pa Paw trail, 29 Sep. 1990, *P. Chantaranonthai, J. Parnell, & D. Simpson* 90/443 (K, KKU); Loei, Phu Kradueng National Park, *P. Jadprajong* 212 (BCU); *ibid.*, *P. Jadprajong* 213 (BCU); Tak, Umphang, Thung Yai Naresuan Wildlife Sanctuary, c 461 m, 20 Sep. 2014, *P. Muangthong* 11 (PSU); Phayao, Mueang Phayao, Mae Ka, University of Phayao, 395 m, 9 Aug. 2009, *P. Nangngam* 1861 (BKF); Phetchabun, Nam Nao National Park, 10 Aug. 2008, *P. Phromprasit* 217 (KKU); *P. R.* 31 (BKF); Chiang Rai, Khun Korn Waterfalls, 1,000 m, 14 Mr. 1997, *P. Ratchata* 112 (BCU); *ibid.*, 750 m, 12 Oct.



1997, *P. Ratchata* 205 (BCU); *ibid.*, 650 m, 9 Jul. 1998, *P. Ratchata* 290 (BCU); Phitsanulok, 4 Dec. 1966, *Prayad* 562 (BK); Chiang Rai, Chiang Khong, *Prayad* 1157 (BK); Satun, 26 Jan. 1924, *Put for Eryl Smith* 2686 (K); Rayong, Ban Pe, *Put for Eryl Smith* 2781 (BK, K); Kamphaeng Phet, Khlong Lan, 350 m, 27 Aug. 1983, *R. Chaveerach* 21 (BCU); Trat, Ko Chang, c 12° 20' N, 102° 10' E, 0 m, 3 Aug. 1973, *R. Geesink & C. Phengklai* 6269 (BKF, L); Tak, Lan Sang National Park, 350 m, 29 May 1973, *R. Geesink, D. Phanichapol & T. Santisuk* 5513 (BKF, L); Chiang Mai, Fang, c 19° 20' N, 98° 50' E, c 400 m, 7 Jun. 1973, *R. Geesink, D. Phanichapol & T. Santisuk* 5747 (BKF, L); Trat, Ko Chang, Ao Ong Kang, c 12° N, 102° 40' E, 30 m, 7 May 1974, *R. Geesink, T. Martink, C. Phengklai* 6583 (BKF, K, L); Chaiyaphum, Ban Nam Phrom, Chulabhorn Dam, c 15° 40' N, 102° E, 800 m, 26 May 1974, *R. Geesink, T. Martink, C. Phengklai* 7001 (K, L); Saraburi, Namtok Samlan National Park, c 14° 30' N, 101° 10' E, 150 m, 18 May 1974, *R. Geesink, T. Martink, J. F. Maxwell* 6817 (K, L); Phitsanulok, Chat Takan, Phu Miang-Phu Thong Wildlife Sanctuary, 650 m, 24 Sep. 2010, *Romklao Botanical Garden* 0089/2553 (QBG); Lampang, Huai Tak, c 400 m, 8 Aug. 1964, *R. Suvarnasara* 44 (BKF, L); Uthai Thani, Ban Rai, Khao Din Daeng, 28 May 1974, *S. Sutisorn* 3029 (BK); Nakhon Ratchasima, Wang Nam Khiao, 13 Aug. 1967, *Sanoh* 138 (BKF); Sakon Nakhon, Phu Phan National Park, c 380 m, 15 Nov. 1984, *S. Mitsuta, T. Yahara, H. Nagamasu, C. Nantasan & N. Nantasan* T-50390 (BKF); Chiang Mai, Doi Suthep-Pui National Park, 700 m, 23 Jul. 1993, *S. Premwichit* 23 (BKF, CMUB, L); Prachuap Khiri Khan, Huai Yang Waterfall National Park, 500 m, 4 Aug. 2014, *Sirisak W.* 054 (BCU); *ibid.*, *Sirisak W.* 068 (BCU); Nakhon Nayok, Khao Yai National Park, Heaw Narok Waterfalls, *Sirisak W.* 085 (BCU); Chiang Mai, Doi Suthep-Pui National Park, 558 m, 20 Jul. 1979, *S. Namnuan* 28 (CMUB); Tak, Doi Pang Kluay, 630 m, 22 Dec. 1965, *S. Phengnaren* s.n. (BKF); Loei, Phu Luang Wildlife Sanctuary, 26 Aug. 1966, *S. Phusomsaeng & K. Bunchuai* 16 (BKF, K, L); Chaiyaphum, Phu Khiao Wildlife Sanctuary, 830 m, 1 Sep. 2001, *S. Pimpa* 50 (BCU); Ubon Ratchathani, Pu Chong Na Yoi National Park, Kaeng Ka Lao, Kaeng Lam Duan, Kaeng Sila Thip, 170–500 m, 10 Dec. 2000, *S. Sooksoi* 59 (KKU); Phangnga, Khura Buri, Ko Surin, 25 Apr. 2009, *S. Wathana & P. Srisanga* 3273 (QBG); Uthai Thani, Lan Sak, Huai Kha Kaeng Wildlife Sanctuary, To Jone Waterfalls, 280–330 m, 12 Nov. 1979, *T. Shimizu, H. Toyokuni, H. Koyama, T. Yahara & C. Niyomdham* T-22247 (BKF, L); Rayong, Khao Chamao-Khao Wong National Park, 50–150 m, 23 Nov. 1979, *T. Shimizu, H. Toyokuni, H. Koyama, T. Yahara and D. Phanichaphol* T-23422 (L); Chanthaburi, Khao Khitchakut National Park, Kra Ting Waterfalls, 80 – 310 m, 29 Nov. 1979, *T. Shimizu, H. Toyokuni, H. Koyama, T. Yahara & D. Phanichaphol* T-23964 (BKF); Chaiyaphum, forest at ridge of Nam Phrom Dam, 900 m, 13 Aug. 1977, *T. Boonkerd* 38 (BCU); Nakhon Ratchasima, Sakaerat Environmental Research Station, 310 m, 8 Apr. 1974, *T. Boonkerd* 49 (BCU); Nakhon Ratchasima, Sakaerat Environmental Research Station, 400 m, 23 May 1974, *T. Boonkerd* 50 (BCU); *ibid.*, *T. Boonkerd* 51 (BCU); *ibid.*, 350 m, 27 May 1974, *T. Boonkerd* 109 (BCU); *ibid.*, 410 m, 27 May 1974, *T. Boonkerd* 110 (BCU); *ibid.*, 450 m, 27 May 1974, *T. Boonkerd* 111 (BCU); Phetchabun, Nam Nao National Park, 920 m, 21 Oct. 1993, *T. Boonkerd* 1307 (BCU); Chanthaburi, Khao Sabap, 18 Sep. 1992, *T. Boonkerd* 1377 (BCU); *T. Boonkerd* 2005 (BCU); *T. Boonkerd* 2049 (BCU); *T. Boonkerd & R. Pollawatn* 268 (BCU); Phitsanulok, Phitsanulok Wildlife Development and Extensive Conservation Station,

120 m, 19 Jan. 2008, *T. Morikul & R. Jansim* 1 (BKF); Lampang, Huai Tak Forest Station, 320 m, 22 Sep. 1967, *T. Shimizu* T-10578 (BKF, K, L); Prachuap Khiri Khan, Bang Saphan, c 150 m, 20 Aug. 1967, *T. Shimizu & A. Nalampoon* T-7765 (BKF); Lampang, Doi Pa Lad, 600 m, 26 Sep. 1967, *T. Shimizu, H. Koyama & A. Nalampoon* T-10844 (BKF, L); Chiang Mai, Doi Suthep-Pui National Park, 500–900 m, 18 Sep. 1967, *T. Shimizu, H. Koyama & M. Hutoh* T-10481 (BKF, E, K, L); Loei, Pha Nok Khao, 150–400 m, 2 Sep. 1967, *T. Shimizu, M. Hutoh & D. Chaiglom* T-8701 (BKF, L); Loei, Phu Kradueng National Park, 600–800 m, 3 Sep. 1967, *T. Shimizu, M. Hutoh & D. Chaiglom* T-8753 (BKF); Khon Kaen, Chum Phae, Dong Lan, c 300 m, 27 Mar. 1952, *T. Smitinand* 1237 (BKF, K); Trat, 50 m, 19 Jun. 1952, *T. Smitinand* 1310 (BKF); Chaiyaphum, Phu Khiao Wildlife Sanctuary, 100 m, 20 Jul. 1973, *T. Smitinand* 11865 (BKF); Trat, Ko Chang, Khao Salak, c 30 m, 23 Feb. 1955, *T. Smitinand* 2283 (BKF, L); Phetchabun, Nam Nao National Park, 600 m, 20 May 1951, *T. Smitinand & Ploenchit* 478 (BKF); Chanthaburi, Namtok Phlio National Park, 19 Jan. 1958, *T. Sørensen, K. Larsen, and B. Hansen* 551 (K); Chiang Mai, Fang, 600 m, 27 Feb. 1958, *T. Sørensen, K. Larsen, and B. Hansen* 1722 (E, K); Chiang Mai, Doi Suthep National Park, 850 m, 28 Jul. 1958, *T. Sørensen, K. Larsen, and B. Hansen* 4518 (BKF, K); Kanchanaburi, Sai Yok, Tao Dam Forest, 350 m, 9 Aug. 2001, *T. Vongthavone* 072 (BK, BKF); Ranong, Ko Phayam Islands, c 150 m, 24 Apr. 2006, *T. Wongprasert* 064-28 (BKF); Ranong, Ko Phayam Islands, Ko Sin Thai, sea level, 25 Apr. 2006, *T. Wongprasert & S. Khao-iam* 064-100 (BKF); Chiang Mai, Doi Suthep-Pui National Park, 600 m, 6 Nov. 1993, *U. Intorn* 11 (CMUB, L); Phetchabun, Chon Daen, 24 Jan. 1969, *Vacharapong* 385 (BK); Phetchabun, Nam Nao National Park, Huai Dong Bag, 11 Oct. 2012, *W. Balee, K. Makgomol* 959 (KKU); Lampang, 600 m, Feb. 1922, *Winit* 898 (BKF, K); Sukhothai, Ramkhamhaeng National Park, 297 m, 10 Sep. 2010, *W. La-onsri & M. Norsaengsri* 1128 (QBG); Nan, Song Khwae, Tham Sakoen National Park, Pha Au, *W. La-onsri, M. Norsaengsri, P. Panyachan, P. Tatiya & S. Satatha* 1919 (QBG); Phayao, Chiang Kham, Rom Yen, Ban Huai Sa, Doi Huai Sa, 493 m, 13 Dec. 2012, *W. La-onsri, M. Norsaengsri, P. Panyachan, P. Tariya & S. Satatha* 2550 (QBG); Loei, Na Haeo, c 1,200 m, 20 Jun. 1995, *W. Nanakorn et al.* 3164 (QBG); *ibid.*, c 1,000 m, 24 Jun. 1994, *W. Nanakorn et al.* 3189 (QBG); *ibid.*, c 700 m, 20 Jun. 1995, *W. Nanakorn et al.* 3801 (QBG); Mae Hong Son, Mueang Mae Hong Son, Huai Hi, 800 m, 13 Mar. 2011, *W. Pongamornkul* 3010 (QBG); Chanthaburi, Namtok Phlio National Park, 14 Aug. 1994, *W. Somprasong* 304 (BK); Phetchabun, Nam Nao National Park, 10 Nov. 2011, *W. Suwonnachot, K. Makgomol* 929 (KKU); Chanthaburi, Khao Soi Dao Wildlife Sanctuary, 22 Dec. 1984, *Y. Paisooksantivatana* y1508-84 (BK); Prachuap Khiri Khan, Huai Yang Waterfall National Park, 100–400 m, 20 Nov. 1999, *Y. Yuyen* 156 (BCU);

**INDIA:** *Helper* 16 (BM (photo), *Wallich* s.n. (BM); **Assam,** *G. Mann* s.n. (BM, L), *J.J.* 225 (B), *S. Wallich* 44/215 (L); **BANGLADESH:** **Chittagong,** *J.J.* s.n. (B), *P.F. Lu, W.L. Chiou, S.J. Moore, Y.M. Huang* 16251 (TAIF); **Dhaka,** *C.B. Clarke* 17202F (BM); **CHINA:** **Yunnan,** *M. Kato, Y. Shimizu, N. Murakami, S. Akiyama and X. Cheng* 1517, 2638 (BM); **Guizhou,** *F. Wang et al.* 210 (L), *J. Cavalerie* 3391 (BM, K, P); **Hainan,** *C.I. Lei* 962 (PE), *F.A. McClure* 8029 (K), *H. Fung* 20035 (K, PE), *Nooteboom & Ye* 5687 (L), *S.K. Lau* 6388 (PE), *W.T. Tsang* 17062 (PE); **Taiwan,** *B.J. Wang* 15038, 17162 (TAIF), *Maries* s.n. (K), *M.J. Jung*

173 (TAIF), *P.F. Lu* 3553, 9117, 10515, 12161, 17153, 18233, 19231, 19488, 22975, 28123 (TAIF), *S.J. Yang* 29824 (TAIF), *U. Faurie* 70 (L), *W.H. Wu* 641, 642 (TAIF), *Y.H. Chang* 20140503-017, 20140503-024 (TAIF); **MYANMAR: Kayin**, *C.R. Fraser-Jenkins* 32152 (TAIF); **Thanlyin**, *F.G. Dickason* F462 (BM); **Moulmein**, *F.G. Dickason* 6844 (BM, L); **Tavoy**, *F.G. Dickason* 7977 (L); **LAOS: J.F. Maxwell** 97-1165, 99-261 (CMUB, L), *M.F. Newman*, *P.I. Thomas*, *K.E. Armstrong*, *K. Sengdala* & *V. Lamxay* LAO 191 (E), *M.P. Tixier* 13 (P), *T. Wongprasert* s.n. (BKF); **CAMBODIA: J.F. Maxwell** 01-247 (CMUB, L); **VIETNAM: A. Petelot** 3400 (BM), *Colani* 3407 (BM), *H. Poilane* 9926 (BM), *L. Pierre* 18 (P), *Schmid* 255, 257, 2077 (P); **MALESIA: Peninsular Malaysia**, *Kiah* 35315 (BM), *M. Nur* s.n. (BM); **Sumatra**, *Matthew* 706 (K).

**20. *Tectaria keckii*** (Luer. & Holttum) C. Chr., *Index Filic.*, *Suppl. Tert.*: 181. 1934; Holttum, *Gard. Bull. Singapore* 9(2): 137. 1937; *ibid.* 34: 143. 1981; *Fl. Males.*, *Ser. 2*, *Pterid.* 2: 72, f. 13d. 1991; I.M. Turner, *Gard. Bull. Singapore* 47(1): 54. 1995; Boonkerd & Pollawatn, *Pterid. Thailand*: 214. 2000. S. Linds., D.J. Middleton, Boonkerd & Suddee, *Thai For. Bull., Bot.* 37: 97. 2009. Type: Malaysia 'Klang bei den Gua Batu', *F. Kehding* 2817 [holotype B! (B 20 0166122)].

*Aspidium keckii* Luer. & Holttum, *Bot. Centralbl.* 11: 76. 1882. Type: as for above.

*Aspidium amplifolium* Alderw., *Bull. Jard. Bot. Buitenzorg*, *Ser. 2*, 11: 2. 1913; *Malay. Ferns Suppl.*: 197. 1917. Type: Malaysia, Perak, *C.G. Matthew* 509 [holotype BO, isotypes K! (K000236364, K000236365)].

*Tectaria amplifolia* (Alderw.) C. Chr., *Index Filic.*, *Suppl. Tert.*: 176. 1934; Holttum, *Rev. Fl. Malaya* ed. 1, 2: 515. 1955 ['1954']; S.C. Chin, *Gard. Bull. Singapore* 30: 190. 1977; Tagawa & K. Iwats., *Acta Phytotax. Geobot.* 23: 56. 1968; *Fl. Thailand* 3(3): 376. 1988; Boonkerd & Pollawatn, *Pterid. Thailand*: 210. 2000; S. Linds., D.J. Middleton, Boonkerd & Suddee, *Thai For. Bull., Bot.* 37: 97. 2009. Type: as for *A. amplifolium*.

*Rhizome* short, erect, densely scaly at apex; *scales* basifixed, concolorous, deep castaneous, 3–8 × 0.5–1 mm, linear-lanceolate, apex acuminate, margin entire. *Fronde* monomorphic, lamina bipinnatifid to bipinnate at base, bipinnatifid upwards; stipe castaneous to dark brown, glossy, grooved, 13.0–50.0 cm long, covered with short hairs throughout, densely scales at nearly base; lamina 13.0–50.0 × 6.0–24.0 cm, ovate-subdeltoid; basal pinnae 11.0–25.0 × 7.0–15.0 cm, opposite, stipitate, stalk 2.5–3.5 cm long, ovate, apex acuminate, base cuneate, margin deeply lobed to 1/2 towards costa, lobes lanceolate-subtriangular, apex acute, margin entire, basal basispic pinnules or basal basispic lobes usually the longest; basal basispic pinnules or basal basispic lobes 7.0–9.0 × 2.0–3.0 cm, lanceolate, apex acuminate, margin lobed to 1/2 towards costae or costules; apical pinnules or basal acroscopic lobes 6.5–7.5 × 1.5–2.0 cm, sessile or very shortly stalked, lanceolate, apex acuminate, base round to subtruncate, margin entire to shallowly lobed; terminal pinnules 20.0–24.0 × 9.0–10.0 cm, ovate-subdeltoid, apex acuminate, base cuneate, margin deeply lobed to 4/5 towards margin, lobes becoming smaller from base to apex of terminal pinnules, lanceolate-falcate, apex acute, margin entire or sometimes irregularly crenate; lateral pinnae 2–3 pairs, 7.0–20.0 × 2.0–6.0 cm, opposite or subopposite, stipitate and becoming shortly stalked upwards, stalk 0.1–0.7 cm long, lanceolate, apex acuminate, base acute to round, margin deeply lobed to 1/2–2/3 towards costa, lobes lanceolate-

oblong, apex acute to obtuse, margin entire, interval 4.0–6.5 cm; terminal pinna pinnatifid, 10.0–27.0 × 6.5–15.0 cm, ovate-lanceolate, apex acuminate, base acute to cuneate, margin deeply lobed to 4/5 towards costa, lobes becoming smaller from base towards apex, lanceolate-falcate, apex acute to acuminate, margin subentire to shallowly lobed; chartaceous, glabrous on both surfaces except few short hairs on sinus, midrib and main veins but rather densely hairy on lamina when young, veins more or less visible, fully anastomosing forming irregular areoles with or without free included veinlets, veinlets usually free, forked, costal areoles more or less having free included veinlets, veinlets simple or branched. *Sori* round, dorsal on anastomosing veins, usually arranged in two rows between lateral veins; indusia peltate, round-reniform, persistent.

**Fig. 4.20.**

Thailand.— PENINSULAR: Pattani (Bukit Tapang), Yala (Banang Sata).

Distribution.— Malesia (Peninsular Malaysia).

Ecology.— Growing on limestone rocks.

Note.— It is noted here that type specimen of *T. keckii* kept at B is incomplete. It composes of line drawing and a small piece of original material. Epitypification of this species is needed. In addition, the locality at Bukit Tapang in Pattani province has been still unclear.

Specimens examined.— **THAILAND:** Pattani, Bukit Tapang, Jun. 1899, *D.J. Gwyune Vanghau* 484pt (K, L), Yala, Bannang Sata, 14 Jun. 1930, *Kiah* 24337 (K);

**MALESIA: Peninsular Malaysia,** *A.G. Piggott* 2033, 2036, 2726, 2729, 2730, 2732, 2733 (K), *B.E.G. Molesworth-Allen* 4071 (K), *B.S. Parris, P.J. Edwards* 10449 (K, L), *C. Curtis* 3374 (K), *C.G. Matthew* 94, 509, s.n. (K), *Dr. King's Collector* 4591, 4713 (K), *Dr. King's Collector* 5908 (K, L), *F.E.W. Venning* MA 117 (K), *F. Kehding* 2817 (B), *H.N. Ridley* 81148, s.n. (K), *J. Sinclair* 9867 (K), *K. Imin* FRI 66408, FRI 66445 (K), *K. Imin* FRI 68131 (L), *K. Ogata* KEP 110195 (K, L), *M.R. Handerson* 19304, 23755, 25208, 29708 (K), *M. Nur* s.n. (K), *R. Kiew* RK 1354 (K), *UNESCO Limestone Expedition* 551 (K).

**21. *Tectaria kehdingiana*** (Kuhn) M.G. Price, *Brit. Fern Gaz.* 10(5): 262. 1972; Holttum, *Fl. Males.*, Ser. 2, Pterid. 2: 99, f. 16e. 1991; Subh. Chandra, *Fraser-Jenk.*, Alka Kumari & Archana Sriastava, *Taiwania* 53(2). 197. 2008; Fraser-Jenk., *Bull. Natl. Mus. Nat. Sci.*, Ser. B 38(4). 176. 2012. Type: Sumatra, *F. Kehding* 2991 [holotype B! (B 20 0170369), isotypes K! (K000237165), P! (photo seen P00636717), SING!].

*Luerssenia kehdingiana* Kuhn in *Luerss.*, *Bot. Centralbl.* 11: 77. 1882; Diels in *Engle & Prantl, Nat. Pflanzenfam.* 1, 4: 180-181, f. 93A, B. 1899; Alderw., *Malayan Ferns*: 233. 1908. Type: as for above.

*Aspidium kehdingianum* (Kuhn) Christ, *Famkr. Erde*: 235. 1897. Type: as for *L. kehdingiana*.

*Tectaria shahidiana* Rusea, *Folia Malaysiana* 5: 28, pl. 2, 4, 6, 7, 8. 2004; S. Linds., D.J. Middleton, Boonkerd & Suddee, *Thai For. Bull.*, Bot. 37: 98. 2009. Type: Malaysia, *RG* 702 (holotype UPM, isotype UKMB!).

*Rhizome* short, erect, bearing a tuft of fronds at apex, scaly; *scales* gradually narrowing from base towards apex, up to 3.75 mm long, shining brown with paler margin, the margin hairy. *Fronds* dimorphic, lamina simple. *Sterile fronds*: stipes

castaneous, to 6.6 cm long, with short white hairs; lamina 29.0–48.0 × 4.7–6.7 cm, elliptic-oblong, apex acute, base cuneate, margin entire, glabrous on both surfaces except few short hairs on midrib or main veins beneath, chartaceous to subcoriaceous, venation reticulate forming many areoles and areolules with free included veinlets, veinlets simple or forked. *Fertile fronds*: stipes to 38.0 cm long, with short white hairs; lamina 30.0–38.1 × 1.7–2.1 cm, elliptic-oblong, apex acute, base cuneate, margin subentire to undulate, glabrous on both surfaces except few short hairs on midrib or main veins beneath, chartaceous to subcoriaceous, veins forming two rows of areoles with free included veinlets, veinlets simple. *Sori* large, one to each areole, terminal on included veinlets, covered throughout abaxially, rather deeply impressed on abaxial surface of lamina, indusia peltate, persistent. Fig. 4.21.

Thailand.— PENINSULAR: Nakhon Si Thammarat (Khao Luang National Park, Khao Nan National Park), Phatthalung (Khao Pu-Khao Ya National Park).

Distribution.— India (Nicobar Islands), Malesia (Peninsular Malaysia, Mentawai Islands, Sumatra (type)).

Ecology.—Terrestrial in shady areas near waterfalls in dense evergreen forest at 90–300 m alt.

Vernacular.— Kachot krung ching (กะจอตกรุงชิง).

Note.— Monomorphic frond is also observed, but very rare. If it is observed, the fertile portion is usually confined to the acuminate apex. In addition, I studied the research of Simma (2008). They reported that this species was found only two plants at Tham Mat Cha, Khao Pu-Khao Ya National Park, Phatthalung province although they cannot identify that specimen into species. Their specimens deposited at Department of Botany, Faculty of Science, Kasetsart University. However, I saw those pictures and I have no doubt to confirm those specimens into this species. Moreover, *T. shahidiana* is firstly synonymized into *T. kehdingiana*.

Specimens examined.— **THAILAND**: Nakhon Si Thammarat, Khao Luang National Park, Krung Ching Waterfalls, 8° 43' 16" N, 99° 40' 23" E, 250 m, 12 Feb. 2005, K. Williams, R. Pooma, M. Poopath, V. Chamchumroon 1406 (BKF); *ibid.*, 200–300 m, 6 Jan. 2011, P. Pongkai 70 (BCU); *ibid.*, 140 m, 19 Mar. 2002, S. Suddee and P. Puudjaa 1359 (BKF); *ibid.*, on the way to Krung Ching Waterfalls, 180 m, 26 Mar. 2004, T. Boonkerd & R. Pollawatn 439 (BCU); Nakhon Si Thammarat, Khao Nan National Park, Tham Luang, 26 Jan. 2007, T. Boonkerd, S. Chantanaorrapint & W. Khwaiphphan 415 (BCU);

**MALESIA**: Malay Peninsula, RG 702 (UKMB); Sumatra, F. Kehding 2991 (B (line drawing), K (line drawing), P, SING), C.G.G.J. van Steenis 9299 (K), Mentawai Islands, Sipora Island, C. Boden-Kloss 14766 (K).

**22. *Tectaria laotica*** Tardieu & C. Chr., Notul. Syst. 7: 94. 1938; Fl. Indo-Chine 7(2): 408, f. 46, 1–2. 1941; Tagawa & K. Iwats., Acta Phytotax. Geobot. 26: 60. 1974; Fl. Thailand 3(3): 376. 1988; Boonkerd & Pollawatn, Pterid. Thailand: 214. 2000; Newman et al., Checkl. Vasc. Pl. Lao PDR: 32. 2007; S. Linds., D.J. Middleton, Boonkerd & Suddee, Thai For. Bull., Bot. 37: 98. 2009. Type: Laos, *Poilane* 16087 [holotype P! (photo seen P00644784), isotype BM! (BM001048592)].

*Aspidium laoticum* (Tardieu & C. Chr.) Ching, Bull. Fan Mem. Inst. Biol. Bot. 10(5): 237. 1941. Type: as for *T. laotica*.

*Rhizome* short, erect, bearing a tuft of fronds at apex, densely scaly; *scales* basifixed, concolorous, deep castaneous, 4–8 × 1–2 mm, lanceolate, apex acuminate, margin entire. Fronds monomorphic, bipinnatifid or bipinnate at base, unipinnate to bipinnatifid upwards, the lower pinnae sometimes bipinnate; stipes deep castaneous to purplish, polished, grooved, 25.0–85.0 cm long, covered with a few short hairs throughout, scaly at nearly base; lamina ovate-oblong, 32.0–70.0 × 22.0–40.0 cm, basal pinnae 20.0–35.0 × 11.0–18.0 cm, subopposite, stalked, stalk 1.0–5.0 cm long, ovate-oblong in outline; basal pinnule 13.0–30.0 × 2.0–5.5 cm, lanceolate or linear-lanceolate, often falcate, apex acuminate, base asymmetrically cuneate, margin subentire to broadly shallowly lobed, lobes oblong-ovate, apex obtuse, margin entire; apical pinnule 10.0–21.0 × 2.0–3.0 cm, lanceolate, apex acuminate, base asymmetrically cuneate, margin entire to slightly crenate; terminal pinnule 15.0–25.0 × 5.0–17.0 cm, ovate-subtriangular, apex acuminate, base asymmetrically cuneate, margin trilobed, central lobe 18.0–24.0 × 3.0–5.0 cm, lanceolate or linear-lanceolate, apex acuminate, base oblique, margin entire to broadly shallowly lobed, pairs of lateral lobes 13.0–22.0 × 1.5–3.0 cm, linear-lanceolate, apex acuminate, base oblique or fused with costa, margin entire to slightly crenate; lateral pinnae 2–3 pairs, alternate or subopposite, stalked at lower pinnae and sessile upwards, stalk 0.5–2.0 cm long, 12.0–40.0 × 2.5–13.0 cm, lanceolate or linear-lanceolate, often falcate, apex acuminate, base asymmetrically acute to cuneate, margin subentire to broadly shallowly lobed, long acroscopic lobe often present, up to 3.0 × 1.5 cm, linear-lanceolate, apex acuminate, margin subentire, basal pinnule 2.5–3.0 × 1.0–1.5 cm, if present, lanceolate, sessile, apex acute to obtuse, base subtruncate, margin entire, interval 10.0–13.0 cm; terminal pinna 15.0–34.5 × 11.0–21.0 cm, ovate-lanceolate, apex acute, base acute or slightly cuneate, margin subentire or trilobed, central lobe 12.0–30.0 × 2.5–7.5 cm, lanceolate, apex acute to acuminate, subentire to shallowly lobed, pairs of lateral lobes 5.0–18.0 × 1.5–3.0 cm, lanceolate, often falcate, apex acute to acuminate, subentire to shallowly lobed; chartaceous, glabrous on both surface except few short hairs on sinus, midrib and main veins, veins fully anastomosing forming irregular areoles with free included veinlets, veinlets free, simple or forked, costal areoles having free branched included veinlets. *Sori* round, terminal on free included veinlets or dorsal on anastomosing veins, usually marginal and confined to the apical margin of lobes; indusia round-reniform, thin, dorsifixed, persistent. **Fig. 4.22.**

Thailand.— NORTHERN: Lampang, Phitsanulok (Phu Hin Rong Kla National Park); NORTH-EASTERN: Loei (Phu Kradueng National Park, Phu Suan Sai National Park); EASTERN: Chaiyaphum (Phu Khiao Wildlife Sanctuary); CENTRAL: Nakhon Nayok (Khao Yai National Park).

Distribution.— Laos (type), Vietnam.

Ecology.— Terrestrial in shaded area in hill evergreen forest at 1,000–1,500 m alt.

Vernacular.— Kut lao (กูดลาว).

Specimens examined.— **THAILAND:** Phitsanulok, Phu Hin Rong Kla National Park, 3 Aug. 2012, AR 070 (BCU); AR s.n. (BCU); *ibid.*, Rom Klao-Pharadon Waterfalls, 17° N 101° E, 2 Oct. 1990, *P. Chantaranothai, J. Parnell & D. Simpson* 90/561 (K, KKU); Phitsanulok, Phu Hin Rong Kla National Park, 10 Jul. 2014, *Sirisak W.* 010 (BCU); *ibid.*, *Sirisak W.* 011 (BCU); *ibid.*, *Sirisak W.* 012

(BCU); *ibid.*, *Sirisak W.* 013 (BCU); Loei, Na Haeo, Phu Suan Sai National Park, 17° 30' 46" N 100° 57' 20.7" E, 1,303 m, 4 Apr. 2015, *Sirisak W.* 093 (BCU); Phitsanulok, Phu Hin Rong Kla National Park, 22 Oct. 2003, *T. Boonkerd* 1689 (BCU); *ibid.*, 1,267 m, 27 Jan. 2010, *T. Boonkerd & R. Pollawatn* 530 (BCU); Loei, Phu Kradueng National Park, Huai Tham Yai, 1,250 m, 12 Jul. 1959, *T. Smitinand* 5917 (BKF); Chaiyaphum, Phu Khiao Wildlife Sanctuary, 1,000 m, 21 Jul. 1973, *T. Smitinand* 11852 (BKF); Lampang, 1,200 m, 26 Apr. 1922, *Winit* 31-900 (BKF); Nakhon Nayok, Khao Yai National Park, Khao Khaew, 2 Jun. 2004, *W. Khwaiaphan* 096 (BCU); Loei, Na Haeo, c 1,200 m, 25 Apr. 1994, *W. Nanakorn et al.* 3151 (QBG); Phitsanulok, Phu Hin Rong Kla National Park, *W. Rattanathirakul* 096 (BCU); *ibid.*, 28 Jul. 2002, *W. Rattanathirakul* 184 (BCU); *ibid.*, *W. Rattanathirakul* 211 (BCU); *ibid.*, *W. Rattanathirakul* 212 (BCU); *ibid.*, *W. Rattanathirakul* 216 (BCU);

**LAOS:** *Poilane* 16087 (BM, P); **VIETNAM:** *Schmid* VN 254 (P).

**23. *Tectaria manilensis*** (C. Presl) Holttum, *Ind. Fern J.* 1: 36. 1984; *Kew Bull.* 43(3): 478. 1988; Tagawa & K. Iwats., *Fl. Thailand* 3(4): 621. 1988; Holttum, *Fl. Males.*, Ser. 2, Pterid. 2: 45. 1991; I.M. Turner, *Gard. Bull. Singapore* 47(1): 55. 1995; Boonkerd & Pollawatn, *Pterid. Thailand*: 214. 2000; S. Linds., D.J. Middleton, Boonkerd & Suddee, *Thai For. Bull., Bot.* 37: 97. 2009. Type: Philippines, Luzon, Manila, *Meyen* s.n. [holotype PRC! (photo seen PRC 450263), photo K!].

*Lastrea manilensis* C. Presl, *Epimel. Bot.*: 39. 1851 [‘1849’]. Type: as for above.

*Ctenitis manilensis* (C. Presl) Holttum, *Novit. Bot. Inst. Horto Bot. Univ. Carol.* 1968: 36. 1969; K. Iwats., *Acta Phytotax. Geobot.* 25(2–3): 71. 1972; Tagawa & K. Iwats., *Fl. Thailand* 3(3): 358. 1988. Type: as for *L. manilensis*.

*Nephrodium parishii* Hook., *Sp. Fil.* 4: 131, t. 260. 1862. Type: Myanmar, Moulmein, *C.S. Parish* s.n. [holotype K! (K001080676)].

*Lastrea parishii* (Hook.) Bedd., *Ferns Brit. India*: t. 43. 1865; *Handb. Ferns Brit. India*: 259, f. 134. 1883. Type: as for *N. parishii*.

*Lastreopsis parishii* (Hook.) Ching, *Bull. Fan Mem. Inst. Biol.* 8: 159. 1938; Holttum, *Rev. Fl. Malaya* ed. 1, 2: 498, f. 294. 1955 [‘1954’]; *Dansk Bot. Ark.* 23: 238. 1965. Type: as for *N. parishii*.

*Lastrea chupengensis* Ridl., *J. Str. Br. Roy. Asiat. Soc.* 59: 232. 1911. Type: Malaysia, *Ridley* 14769 [holotype K! (K000236400)].

*Lastreopsis parishii* (Hook.) Ching var. *chupengensis* (Ridl.) Holttum, *Rev. Fl. Malaya* ed. 1, 2: 498. 1955 [‘1954’]. Type: as for *L. chupengensis*.

*Tectaria manilensis* var. *chupengensis* (Ridl.) Holttum, *Fl. Males.*, Ser. 2, Pterid. 2: 45. 1991; I.M. Turner, *Gard. Bull. Singapore* 47(1): 54. 1995; Boonkerd & Pollawatn, *Pterid. Thailand*: 214. 2000. Type: as for *L. chupengensis*.

*Athyrium loheri* Christ, *Bull. Herb. Boissier*, sér. 2, 6: 1001. 1906. Type: Philippines, Luzon, *Loher* s.n. [holotype P! (photo seen P01388466)].

*Ctenitis loheri* (Christ) Copel., *Fern Fl. Philipp.*: 287. 1960. Type: as for *A. loheri*.

*Rhizome* short, creeping, scaly; *scales* basifixed, concolorous, clathrate, dark brown, 1–2 × 0.5–1 mm, ovate, apex acuminate, margin minutely toothed. *Fronds* monomorphic, lamina tripinnatifid to tripinnate at base, bipinnatifid to bipinnate upwards; stipes stramineous to pale brown, grooved, 3.5–36.0 cm long, covered with

short hairs throughout, costae, costules and rachis usually winged; lamina ovate-subdeltoid, 7.0–30.0 × 4.5–29.0 cm; basal pinnae 6.0–18.0 × 3.0–11.0 cm, stalked, stalk 0.5–1.0 cm long, ovate-subdeltoid, apex acuminate, base cordate, margin deeply lobed; basal basicopic pinnules 1.0–8.0 × 0.5–2.5 cm, lanceolate-oblong, apex acuminate, margin deeply lobed to 4/5 towards costa, lobes lanceolate-oblong, apex acute, margin crenate to lobed; basal acroscopic lobes 1.0–3.5.0 × 0.5–1.5 cm, lanceolate, apex acute, margin deeply lobed to 4/5 towards costa, lobes lanceolate-oblong, apex acute, margin crenate to lobed; lateral pinnae up to 10 pairs, upper pinnae gradually becoming smaller, alternate to subopposite, stalked at lower pinnae and sessile upwards, stalks 0.1–0.3 cm long, 3.0–10.0 × 1.0–3.5 cm, lanceolate-oblong, apex acuminate, base cuneate or fused with costae, margin deeply lobed to 4/5 towards costae, lobes lanceolate-oblong, apex acute, margin crenate to lobed, interval 1.0–4.0 cm; ultimate lobes oblong, apex acute, margin entire; herbaceous, pubescent on both surface, covering with short white hairs throughout, densely hairy on costae, costules and midrib, veins all free. *Sori* round, terminal and dorsal on short acroscopic branches of veinlets, arranged in two rows between main veins; indusia round-reniform, thin, dorsifixed, caducous. **Fig. 4.23.**

Thailand.— **NORTHERN:** Mae Hong Son (Pang Mapha), Chiang Mai (Chiang Dao Wildlife Sanctuary, Doi Lin Luang), Nan (Tham Sakoen National Park), Lampang (Chae Son National Park, Ngao, Tham Pha Thai National Park), Phrae [Mae Yom National Park, Rong Kwang (Mae Sai)], Tak (Khun Phawo National Park, Mae Sot, Umphang); **NORTH-EASTERN:** Phetchabun (Sap Chomphu Arboretum), Loei (Phu Kradueng National Park), Sakon Nakhon (Phu Phan National Park); **CENTRAL:** Saraburi (Chaloem Phra Kiat, Muak Lek, Namtok Samlan National Park); **EASTERN:** Chaiyaphum (Phu Khiao Wildlife Sanctuary), Nakhon Ratchasima (Khao Sisiat, Khao Yai National Park, Pak Thong Chai); **SOUTH-EASTERN:** Chantaburi (Kaeng Hang Maeo); **SOUTH-WESTERN:** Kanchanaburi (Dong Yai, Sai Yok, Thong Pha Phum), Prachuap Khiri Khan (Khao Luang); **PENINSULAR:** Chumphon, Surat Thani (Kanchanadit, Khiri Rat Nikhom), Phangnga (Khao Nang Hong, Tham Pha Phueng, Thap Put), Krabi (Khao Pra – Bang Khram Wildlife Sanctuary, Klong Chilat), Nakhon Si Thammarat (Khao Luang National Park, Khao Nan National Park, Thung Song), Trang (Huai Yot, Khao Chong), Satun (Thale Ban National Park, Than Plieo Waterfalls, Thung Wa).

Distribution.— Myanmar (Kayin, Moulmein), Vietnam, Malesia [Peninsular Malaysia, Sulawesi, Philippines [(Luzon (type), Coron, Palawan)]].

Ecology.— Growing in rock crevices or on cliffs in moist and shaded area near stream banks in evergreen or deciduous forest, usually on limestone bedrock and rarely on sandstone bedrock at below 100–900 m alt.

Vernacular.— Kut khi lap (กูดขี้หัดับ) (Northern); Nin pu si kao (นิลพู่สีเขา) (Peninsular).

Note.— The fronds usually expand only in the rainy season, and the rhizome is fleshy and succulent, storing plants for survival in the dry season.

Specimens examined.— **THAILAND:** Nakhon Ratchasima, Pak Chong, Khao Sisiat Ar, 14° 35' 55" N 101° 16' 27" E, c 300 m, 1 Sep. 1924, *A.F.G. Kerr* 9090 (BK, BM); Prachuap Khiri Khan, Khao Luang, c 300 m, 3 Jul. 1926, *A.F.G. Kerr* 10795 (BK, BM, K); Surat Thani, c 50 m, 5 Aug. 1927, *A.F.G. Kerr* 13173 (BK, BM, K); Ranong, Khao Tan, c 50 m, 3 Feb. 1927, *A.F.G. Kerr* 11792 (BM, K); Surat



Thani, Kanchanadit, c 500 m, 31 Jul. 1927, *A.F.G. Kerr* s.n. (BK); Kanchanaburi, Sai Yok, 100–150 m, 31 Jul. 1946, *A. Kostermans* 1420 (BM); Saraburi, Muak Lek, 300 m, 11 Nov. 1924, *A. Marcan* 1882 (BM); Chaiyaphum, Phu Khiao Wildlife Sanctuary, *A. Sathapattayanon* 768 (BCU); *ibid.*, *A. Sathapattayanon* 808 (BCU); Nakhon Ratchasima, Pak Thong Chai, Salika forest, 400 m, 25 Oct. 1971, *C.F. van Beusekom, C. Wid, R. Geesink* 3360 (BKF, BM, L); Kanchanaburi, Dong Yai, 700 m, 14 Aug. 1971, *CP, BN, BS* 2932 (BKF); Phrae, Mae Pan, 14 Sep. 1929, *C.W. Franck* s.n. (L); Satun, Khuan Don, Thale Ban National Park, along cliffs face from Ton Din Cave, 6° 43' 40" N 100° 9' 43" E, 130 m, 9 Sep. 2010, *D.J. Middleton, K. Bunpha, P. Karaket, S. Lindsay, T. Phutthai, S. Suddee & N. Tetsana* 5349 (BKF, E); Nan, Song Khwae, Tham Sakoen National Park, 19° 22' 10" N 100° 32' 26" E, 700 m, 14 Aug. 2012, *D.J. Middleton, P. Karaket, S. Suddee & P. Triboun* 5595 (BKF, E); Tak, Mae Sot, Wat Tham Inthanin, 16° 46' N 98° 40' 20" E, 500 m, 11 Sep. 2009, *D.J. Middleton and P. Triboun* 4847 (E); Surat Thani, Khiri Rat Nikhom, Khao Photha Daeng Lam, 8° 58.2' N 98° 58.9' E, 60 m, 6 Sep. 2008, *D.J. Middleton, P. Triboun, V. Chamchumroon, S. Saengrit & R. Simma* 4287 (BKF, E); Surat Thani, Ban Ta Khun, Khao Sok National Park, 9° 1' N 98° 44' 20" E, 100 m, 6 Sep. 2008, *D.J. Middleton, P. Triboun, V. Chamchumroon, S. Saengrit & R. Simma* 4325 (E); Surat Thani, Khiri Rat Nikhom, Tham Wang Badan, 8° 55' N 98° 57' E, 180 m, 8 Sep. 2008, *D.J. Middleton, P. Triboun, V. Chamchumroon, S. Saengrit & R. Simma* 4366 (BKF, E); Tak, Doi Pha Wo, c 50 km from Doi Muser, c 600 m, 21 Nov. 1965, *E. Hennipman* 3098 (BKF, L); Chiang Mai, 300 m, Oct.-Nov. 1922, *E. Smith* 1246 (K); Tak, c 150 m, Aug.-Sep. 1924, *E. Smith* 3054 (BM, K); *ibid.*, *E. Smith* 3055 (K); Tak, Khao Pha Wo, c 750 m, 23 Jul. 1973, *G. Murata, N. Fukuoka & C. Phengkklai* T-16936 (BKF, K, L); Krabi, Khlong Thom, Khao Phra-Bang Khram Wildlife Sanctuary, 100 m, 8 Aug. 2006, *J.F. Maxwell* 06-538 (CMUB, L); Mae Hong Son, Pang Mapha, 650 m, 16 Aug. 2012, *J.F. Maxwell* 12-268 (CMUB, QBG); Kanchanaburi, Thong Pha Phum, 600 m, 4 Jul. 1973, *J.F. Maxwell* 73-93 (BK); Saraburi, Mueang Saraburi, Namtok Samlan National Park, 150 m, 13 Oct. 1973, *J.F. Maxwell* 73-456 (BK); *ibid.*, 125 m, 29 Jun. 1974, *J.F. Maxwell* 74-633 (BK, L); Trang, Khao Chong, 150 m, 15 Aug. 1975, *J.F. Maxwell* 75-882 (BK, L); Phrae, Song, Mae Yom National Park, 225 m, 10 Oct. 1991, *J.F. Maxwell* 91-865 (L); Tak, Mae Sot, 200 m, 18 Aug. 1994, *J.F. Maxwell* 94-897 (BKF, CMUB, L); Lampang, Mueang Pan, Chae Son National Park, 525 m, 25 Aug. 1995, *J.F. Maxwell* 95-580 (BKF, CMUB, L); Lampang, Wang Nuea, Chae Son National Park, 550 m, 3 Nov. 1996, *J.F. Maxwell* 96-1482 (BKF, CMUB, L); Krabi, Khlong Chi Lat, 50 m, 13 Jul. 1992, *K. Larsen, S.S. Larsen, C. Niyomdham, P. Sirirugsa, D.D. Tirvengadum, C.T. Nørgaard* 43341 (BKF); Phangnga, Khao Nang Hong, 8° 32' N 98° 33' E, 100–150 m, 20 Jul. 1972, *K. Larsen, S.S. Larsen, I. Nielsen & T. Santisuk* 31173 (P); Chiang Mai, Fang, along Highway 107 from Fang to Chiang Mai, 400 m, 27 Jul. 1968, *K. Larsen, T. Santisuk & E. Warncke* 2758 (BKF, E, K, L); Nakhon Ratchasima, eastern part of Khao Yai National Park, 80 km at the Nakhon Ratchasima-Satthahip Highway, 300 m, 10 Aug. 1968, *K. Larsen, T. Santisuk & E. Warncke* 3251 (BKF, E, K, L); Sakon Sakhon, Phu Pha Yon National Park, Tham Muang, 4 Jul. 1996, *K. Makgomol* s.n. (KKU); Chumphon, Thap Li, 26 May 1918, *M. Haniff & M. Nur* 4624 (K); Chiang Mai, Chiang Dao Wildlife Sanctuary, 500–600 m, 11 Sep. 1967, *M. Tagawa, T. Shimizu, M. Hutoh, H. Koyama & A. Nalampoon* T-9749 (BKF, E, K, L);

Kanchanaburi, 21 Jun. 1926, *Put* 223 (BM, K); Chumphon, 6 Sep. 1927, *Put* 971 (BK, BM, K); Satun, near sea level, 15 Jan. 1924, *Put for Eryl Smith* 2475 (BM, K); Satun, 250 m, 14 Jan. 1924, *Put for Eryl Smith* 2480 (BM, K); Kanchanaburi, between Kri Tee and Huai Ban Kao, 800 m, 7 Dec. 1973, *R. Geesink & C. Phengkklai* 6239 (BKF, BM, L); Sara Buri, Chaloe Phra Kiat, Bencha Khiri Temple, 14° 44' 14" N 100° 54' 41" E, 170 m, 30 Aug. 2001, *R. Pooma, W.J.J.O. de Wilde, B.E.E. Duyffjes, V. Chamchumroon, K. Phattarahirankanok* 2993 (BKF); Phangnga, 30–150 m, 23 Aug. 1967, *T. Shimizu, N. Fukuoka & A. Nalampoon* T-7895 (BKF, E, L); Phangnga, Thap Put, Khao Sam Kob, c 80 m, 24 Aug. 1967, *T. Shimizu, N. Fukuoka & A. Nalampoon* T-7936 (BKF, E, K, L); Nakhon Si Thammarat Thung Song, 28 Aug. 1967, *T. Shimizu & A. Nalampoon* T-8258 (BKF, K, L); *T. Boonkerd* 1800 (BCU); Phetchabun, Nong Phai, Sap Chomphu Arboretum, 183 m, 22 Sep. 2011, *T. Boonkerd* 1933 (BCU); Kanchanaburi, Sai Yok, Dao Dueng Cave, 150 m, 12 Oct. 2011, *T. Boonkerd* 1949 (BCU); Tak, Umphang, 18 Jul. 2008, *T. Boonkerd & R. Pollawatn* 515 (BCU); Tak, Umphang, Ta Ko Bi Cave, 17 May 2011, *T. Boonkerd et al.* 2011-173 (BCU); Chantaburi, Kaeng Hang Maew, Khao Wong Kot, Tao Cave, *T. Boonkerd et al.* 2011-400 (BCU); Phangnga, Mueang Phangnga, Khao Ta Pae, Tham Num Phud, 170 m, 17 May 2012, *T. Boonkerd et al.* 2011-560 (BCU); Trang, Huai Yot, Wat Tham Iso, 130 m, 20 May 2012, *T. Boonkerd et al.* 2011-609 (BCU); Chiang Mai, Chiang Dao, Wat Tham Chiang Dao, 480 m, 25 Jul. 2012, *T. Boonkerd et al.* 2011-648 (BCU); Lampang, Ngao, Tham Pha Thai National Park, 28 Jul. 2012, *T. Boonkerd et al.* 2011-688 (BCU); Nakhon Si Thammarat, Khao Nan National Park, Tham Luang, 11 Jun. 2006, *T. Boonkerd, S. Chantanaorrapint & W. Khwaiphan* 230 (BCU); *ibid.*, 26 Jan. 2007, *T. Boonkerd, S. Chantanaorrapint & W. Khwaiphan* 417 (BCU); Phangnga, Tham Pha Phueng, 24 Oct. 2007, *T. Boonkerd, Y. Sirichamorn & C. Sanguansab* 280 (BCU); Satun, Than Plieo Waterfalls, 26 Oct. 2007, *T. Boonkerd, Y. Sirichamorn & C. Sanguansab* 299 (BCU); Satun, Thung Wa, Khan Ti Khiri House of Priest, 107 m, 26 Oct. 2007, *T. Boonkerd, Y. Sirichamorn & C. Sanguansab* 305 (BCU); Chiang Mai, Doi Lin Luang, 610–780 m, 9 Oct. 1922, *Winit* 977 (BKF, K); Phrae, Rong Kwang, Mae Sai, 900 m, 29 Nov. 1992, *Winit* 978 (BKF, K); Lampang, Ngao, 470–580 m, 31 Jul. 1922, *Winit* 979 (BKF, BM, K); *ibid.*, 350 m, 31 Jul. 1922, *Winit* 980 (BKF);

**MYANMAR:** *Kayin*, *C.R. Fraser-Jenkins* 32123 (TAIF); **Moulmein**, *C.S. Parish* 91, s.n. (K), *H.F. Hance* 11468 (BM), *J. Lobb* 370 (K); **VIETNAM:** *L. Pierre* 18 (P), **MALESIA:** **Peninsular Malaysia**, *C.G. Matthew* s.n. (BM, K), *E.D.H. Corner & M.R. Hudwes* 22876 (BM), *E.D.H. Corner & M.R. Hudwes* 23127 (BM), *Ridley* 14769 (K); **Sulawesi**, *E. Smith* 2431 (K); **Philippines:** **Luzon**, *E.B. Copeland* 2112 (K), *M.G. Price* 2381 (K, L); **Coron**, *M. Ramos* BS 41134 (K).

**24. *Tectaria melanocaula*** (Blume) Copel., *Philipp. J. Sci.*, C 2: 416. 1907, as '*melanocaulon*'; *Backer & Posth.*, *Varenfl. Java*: 74. 1939; Copel., *Philipp. J. Sci.* 77(4): 418. 1949, as '*melanocaulon*'; *Fern Fl. Philipp.*: 306. 1960, as '*melanocaulon*'; *Holtum*, *Rev. Fl. Malaya*, ed. 2, 2: 636. 1968, as '*melanocaulis*'; *Tagawa & K. Iwats.*, *Acta Phytotax. Geobot.* 23: 176. 1968, as '*melanocaulis*'; *C.V. Morton*, *Amer. Fern J.* 61: 148. 1971, as '*melanocaulon*'; *K. Iwats.*, *Amer. Fern J.* 63(3): 131. 1973, as '*melanocaulis*'; *Holtum*, *Gard. Bull. Singapore* 34(1): 143. 1981, as '*melanocaulis*'; *Tagawa*

& K. Iwats., Fl. Thailand 3(3): 367, f. 34.1. 1988, as '*melanocaulis*'; Holttum, Fl. Males., Ser. 2, Pterid. 2: 66. 1991; I.M. Turner, Gard. Bull. Singapore 47(1): 55. 1995, as '*melanocaulis*'; Boonkerd & Pollawatn, Pterid. Thailand: 215. 2000, as '*melanocaulis*'; Subh. Chandra, Fraser-Jenk., Alka Kumari & Archana Sriastava, Taiwania 53(2). 197. 2008, as '*melanocaulis*'; S. Linds., D.J. Middleton, Boonkerd & Suddee, Thai For. Bull., Bot. 37: 98. 2009, as '*melanocaulis*'; Fraser-Jenk., Bull. Natl. Mus. Nat. Sci., Ser. B 38(4). 176. 2012, as '*melanocaulis*'. Type: Java, *Blume* s.n. [holotype L! (photo seen L 0052173), isotypes K! (K000237259), LE! (photo seen LE 00008134), photo BM!].

*Aspidium melanocaulon* Blume, Enum. Pl. Javae: 161. 1828; Hook., Sp. Fil. 4: 53. 1862, excl. syn. *Polypodium latifolium* Forst.; Alderw., Malayan Ferns: 245. 1908. Type: as for above.

*Sagenia melanocaulis* (Blume) T. Moore, Index. Fil.: 96. 1857; Racib., Pteridoph. Buitenzorg: 195. 1898. Type: as for *A. melanocaulon*.

*Polypodium nigripes* Hassk., Cat. pl. Bogor. 4. 1844; Zoll. & Moritz, Nat. Gen. Arch. Neerl. Ind. 1. 397. 1844. Type: *Cult. Hort. Bog.* (BO?).

*Aspidium microsorum* C. Presl, Epim. Bot.: 61. 1851; Holttum, Novit. Bot. Delect. Seminum Horti Bot. Univ. Carol. Prag. 1968: 88. 1968. Type: Philippines, Luzon, *Cuming 57* [holotype PRC! (photo seen PRC 450253), isotypes B! (B 20 0166663, B 20 0166665, B 20 0166666), BM!, K! (K000360658, K000360659, K000360660, K000360661, K000360662), L! (photo seen L 0052174), S! (photo seen S-P-674), US! (photo seen US00624175), Z! (photo seen Z-000002266), photos BM!, K! (K000360663)].

*Rhizome* short, erect, densely scaly at apex; *scales* basifixed, concolorous, castaneous, 5–10 × 1–2 mm, linear-lanceolate, apex acuminate, margin entire. *Fronde* monomorphic, lamina bipinnatifid; stipe and rachis deep purplish to nearly black, glossy, grooved, 35.0–60.0 cm long, covered with short hairs throughout, densely scaly at base; lamina 30.0–50.0 × 20.0–35.0 cm, ovate-subdeltoid; basal pinnae 15.0–22.0 × 8.0–15.0 cm, opposite, stalked, stalk 2.5–3.5 cm long, ovate, apex acuminate, base cuneate, margin deeply lobed to 1/2 towards costa, lobes lanceolate-subtriangular, apex acute, margin entire to lobed, basal basisopic lobe usually the longest; basal basisopic lobes 7.0–9.0 × 2.0–3.0 cm, lanceolate-oblong, apex acuminate, margin lobed; lateral pinnae 2–3 pairs, opposite or subopposite, stalked, stalk 0.3–2.0 cm long, 10.0–22.0 × 3.0–13.0 cm, lanceolate-oblong, apex acuminate, base cordate to asymmetrically round to cuneate, margin deeply lobed to 1/2–2/3 towards costa, lobes lanceolate-subtriangular, often falcate, apex acute, margin entire, interval 7.0–8.0 cm; terminal pinna pinnatifid, 18.0–24.0 × 12.0–22.0 cm, ovate, apex acuminate, base round to cuneate, margin deeply lobed to 4/5 towards costa, lobe lanceolate-falcate, apex acute to acuminate, margin subentire to shallowly lobed; papyraceous to chartaceous, glabrous on both surfaces except few short hairs on sinus, midrib and main veins, venation fully anastomosing forming irregular areoles with free included veinlets, veinlets usually free, forked, costal areoles more or less having free included veinlets, veinlets simple or branched. *Sori* round, terminal on free included veinlets, arranged in two rows between main veins or scattered throughout abaxially; indusia round-reniform, dorsifixed, persistent. **Fig. 4.24.**

Thailand.— PENINSULAR: Nakhon Si Thammarat (Khao Luang National Park), Yala (Bannang Sata).

Distribution.— Madagascar, Sri Lanka, India (Andaman Islands, Nicobar Islands), Malesia [Peninsular Malaysia, Sumatra, Krakatau Islands, Java (type), Bawean, Bali, Sulawesi, Philippines (Luzon, Negros, Sulu Archipelago), Moluccas, New Guinea], Papua New Guinea, Bismarck Archipelago (New Ireland), New Caledonia.

Ecology.— Terrestrial in dense evergreen forest at 70 m alt.

Note.— The specific epithet '*melanocaula*' have been used as the best answer for this taxon due to nomenclatural changes (Holttum, 1981). It is noted here that I agree with the use of epithet '*melanocaula*' for this species.

Specimens examined.— **THAILAND:** Yala, Bannang Sata, 70 m, 23 Jul. 1923, *E. Smith* 1842 (K); Nakhon Si Thammarat, Sichon, Si Khid Waterfall National Park, 30 Mar. 2004, *T. Boonkerd & R. Pollawatn* 1479 (BCU);

**MADAGASCAR:** *Boivin* s.n. (L); **SRI LANKA:** *R.B. & A.J. Faden* 76/586 (K); **MALESIA: Peninsular Malaysia,** *A.G. Piggott* 3076 (K), *B.E.G. Molesworth-Allen* 3985 (K); **Sumatra,** *A.H.G. Alston* 13644 (BM), *A.H.G. Alston* 14435 (BM, L), *Bünnemeyer* 4173, 4318 (L), *C.G. Matthew* s.n. (K), *C.J. Brooks* 86S, s.n. (BM), *H.O. Forbes* 1619a (B, BM), *J.A. Lörzing* 5389, 5414, 5453, 5656 (L), *J.A. Lörzing* 12525 (K, L), *K. Iwatsuki, G. Murata, J. Dransfield & D. Saerudin* S-1691 (L), *Korthals* 407 (L), *O. Beccari* 573 (K), *R.J. Morley & M.K.K. Morley* 605 (L), *W.J.J.O. de Wilde and B.E.E.D. Wilde-Duyffjes* 12691, 14770, 15058, 15507, 22387 (L), *W.J.J.O. de Wilde and B.E.E.D. Wilde-Duyffjes* 18012 (K, L), *Y. Aumeeruddy* YA 460 (K); **Krakatau Islands,** *Krakatau Research Project* KR OXR 32 (K); **Java,** *B. v/d Brink* 3260 (K, L), *B. v/d Brink* 6613 (L), *C. Holstvoogd* 338 (BM, L), *D. Vriese* 9, 297 (K), *D.F.V. Hooker* 513 (L), *Dr. Ploem* 31, 571 (B), *F. Jagor* s.n. (B), *H.O. Forbes* 495 (K), *Horsfield* 221 (BM), *Jagor* s.n. (B), *J.A. Willich* s.n. (K), *Junghuhn* 1902 (L), *JRF, HW, NB, MF, VW, KR, RW, JW* KCE 43 (L), *M. Duysman* s.n. (B), *Mousset* 13 (B, K, L), *Mousset* 45 (B, BM, K, L), *Mousset* 662 (B), *N. Steenis* 2349 (L), *Raciborski* s.n. (L), *Schuurman* 55.760 (K), *V. Schiffner* 27 (L), *W.F. Winckel* 1279β (L), *W.F. Winckel* 1354β (K, L), *W. Palmer, O. Bryant* 1282, 1286 (L), *Winterbottom* s.n. (K), *Zollinger* 1626, 2339 (B, L); **Bawean,** *P. Buwalda* 3217 (L); **Bali,** *F.I. Rensch* 59 (B); **Lesser Sunda Islands,** *P.E. Schmutz* 772 (L), *O. Posthumus* 3703 (L); **Borneo,** *F.H. Inderd* 5126 (B), *J. Dransfield & D. Saerudin* 2260 (L); **Sulawesi,** *A.H.G. Alston* 16435 (BM), *E. Hennipman* 5561a, 5694, 6088 (K, L), *O. Posthumus* 3430 (L), *P.J. Eyma* 3983 (L); **Philippines, Luzon,** *B.S. Parris* 5621 (K), *C.G. Matthew* s.n. (K), *Cuming* 33 (BM), *Cuming* 57 (B, BM (specimens & photo), K (specimens & photo), L, PRC, S, US, Z), *Cuming* s.n. (B), *E.B. Copeland* 1788 (B), *L.A. Loher* s.n. (K (photo)), *M.G. Price* 368, 1322, 1804, 2164, 3133 (K); **Negros,** *A.D.E. Elmer* 9854 (BM, K, L); **Paney,** *G. Edaño* 35349 (BM), *G. Edaño* 35721 (B); **Samar,** *G. Edaño* 24775 (L), *Gutung et al.* 220 (L); **Mindanao,** *D. Mendoza & P. Convocar* PNH 8618 (BM, L); **Sulu Archipelago,** *F.W. Burbidge* s.n. (BM, K); **Moluccas,** *B.S. Parris* 11036 (K, L), *E. Stresemann* 115 (L), *K. Iwatsuki, M. Kato, K. Ueda & U.W. Mahjar* A-17 (L), *K. Iwatsuki, M. Kato, K. Ueda & U.W. Mahjar* A-104 (K, L), *K. Iwatsuki, M. Kato, K. Ueda & U. W. Mahjar* C-641, C-1242 (L), *M. Kato, B. Sunarno and H. Akiyama* C-4161, C-4410 (K, L), *M. Kato, K. Ueda and Z. Fanani* C-11396, C-12423 (L), *M. Kato, K. Ueda, M. Okamoto, H. Akiyama, B.*

*Sunarno and U.W. Mahjar* C-7447 (L); **New Guinea**, *M. J. S. Sands* 6748 (K, L); **PAPUA NEW GUINEA**: *Bamler* 117 (B), *Bamler* 184 (L), *B.S. Parris, J.P. Croxall* 9491 (K, L), *E. Nyman* 964 (B), *M. Peekel* 40 (B); **BISMARCK ARCHIPELAGO**: **New Ireland**, *A.C. Jermy* 8006 (K (line drawing)); **NEW CALEDONIA**: *Vieillard* s.n. (B).

**25. *Tectaria multicaudata*** (C.B. Clarke) Ching, *Sinensia* 2(2): 20. 1931; Dickason, *Ohio J. Sci.* 46(3): 121. 1946; Holttum, *Rev. Fl. Malaya* ed. 1, 2: 507, f. 299. 1955 [‘1954’]; A. Johnson, *A Student’s Guide to the Ferns of Singapore Island*: 83. 1977; H.H. Ding, Y.S. Chao & S.Y. Dong, *Phytotaxa* 122(1): 62. 2013. Type: Bangladesh, Sylhet, *C.B. Clarke* 18427C [holotype K! (K001080692), paratypes *C.B. Clarke* 18427B K! (K001080690), *C.B. Clarke* 18427F BM!, *C.B. Clarke* 18427H K! (K001080691)].

*Nephrodium multicaudatum* C.B. Clarke, *Trans. Linn. Soc. London, Bot.* 1(8): 540, t. 77. 1880. Type: as for above.

*Aspidium multicaudatum* (C.B. Clarke) Bedd., *Handb. Ferns Brit. India*: 222. 1883. Type: as for *N. multicaudatum*.

*Aspidium malayense* Christ, *Philipp. J. Sci.* 2: 187. 1907. Type: Philippines, Luzon, *Loher* 858 [lectotype P! (photo seen P01631072), isolectotype K! (K000236213)].

*Tectaria malayensis* (Christ) Copel., *Philipp. J. Sci.* 2: 416. 1907; C. Chr., *Gard. Bull. Straits Settlement.* 7: 260. 1934; Copel., *Fern Fl. Philipp.*: 305. 1960. Type: as for *A. malayense*.

*Tectaria griffithii* (Baker) C. Chr. var. *singaporeana* Holttum, *Blumea* 35: 551. 1991; *Fl. Males.*, Ser. 2, Pterid. 2: 55. 1991; I.M. Turner, *Gard. Bull. Singapore* 47(1): 54. 1995. Type: Singapore, *C.G. Matthew* s.n. [lectotype (designated here) K! (K000236221), isolectotypes K! (K000236220, K000236222)].

*Tectaria griffithii* sensu auctt. Tardieu & C. Chr. [non (Baker) C. Chr., 1934], *Fl. Indo-Chine* 7(2): 411. 1941, *pro parte*; Holttum *Dansk Bot. Ark.* 23: 240. 1965, *pro parte*, *quoad K. Larsen & T. Smitinand* 9471; Tagawa & K. Iwats., *S. E. Asian Stud.* 5: 97. 1967, *pro parte*, *quoad M. Tagawa, K. Iwatsuki & N. Fukuoka* T-4519; *Acta Phytotax. Geobot.* 23: 55. 1968, *pro parte*, *quoad E. Smith* 1841; Holttum, *Rev. Fl. Malaya*, ed. 2, 2: 636. 1968; *Gard. Bull. Singapore* 34: 137. 1981; C.M. Kuo, *Taiwania* 30: 29. 1985, *pro parte*; Holttum, *Kew Bull.* 43: 484. 1988, *pro parte*; *Fl. Males.*, Ser. 2, Pterid. 2: 54. 1991; I.M. Turner, *Gard. Bull. Singapore* 47(1): 54. 1995; Boonkerd & Pollawatn, *Pterid. Thailand*: 213. 2000, *pro parte*; S. Linds., D.J. Middleton, Boonkerd & Suddee, *Thai For. Bull., Bot.* 37: 98. 2009, *pro parte*; F.W. Xing, Y.H. Yan, S.Y. Dong, F.G. Wang, Christenh. & Hovenkamp, *Fl. China* 2-3: 738. 2013, *pro parte*.

*Rhizome* short, erect or ascending, densely scaly at apex; *scales* basifixed, concolorous, dark brown to castaneous, 5–20 × 0.5–3 mm, linear-lanceolate, apex acuminate, margin entire. *Fronde*s monomorphic, bipinnate or sometimes tripinnate at base, bipinnatifid or bipinnate upwards; stipes pale brown to castaneous, dull, grooved, 35.0–45.0 cm long covered with short hairs throughout, scaly densely at base, sometimes throughout with gradually sparse upwards; lamina oblong-subdeltoid, up to 70.0 cm long and 50.0 cm wide; basal pinnae 20.0–40.0 × 15.0–30.0

cm, stalked, stalk 1.5–7.0 cm long, ovate-subtriangular, deeply lobed; basal pinnule 14.0–22.0 × 5.0–11.0 cm, lanceolate-oblong, apex acuminate, base cuneate, margin lobed to 1/2–2/3 towards, lobes lanceolate-oblong, apex obtuse to acute, margin subentire or crenate; apical pinnule 5.5–12.0 × 1.5–4.0 cm, lanceolate-oblong, apex acuminate, base acute to cuneate, margin crenate or lobed to 1/2 towards, lobes lanceolate, apex obtuse to acute, margin subentire or slightly crenate; terminal pinnule 20.0–30.0 × 12.0–20.0 cm, ovate-subtriangular, asymmetric, apex acuminate, base asymmetrically cuneate, margin deeply lobed to 4/5 towards costule, lobes lanceolate-oblong, apex acuminate, margin crenate or shallowly lobed; lateral pinnae 1–3 pairs, alternate to subopposite, stalked at lower pinnae and gradually sessile upwards, stalk 0.3–2.5 cm long, 14.0–35.0 × 4.0–18.0 cm, lanceolate-oblong, apex acuminate, base cordate, margin deeply lobed to 1/2–2/3 towards costa, lobes lanceolate, apex acute, margin entire, interval 8.0–15.0 cm; terminal pinna 15.0–40.0 × 13.0–24.0 cm, ovate-subtriangular, apex acuminate, base cuneate, margin deeply lobed to 4/5 towards costa, lobe lanceolate-oblong, apex acute to acuminate, margin crenate to lobed; chartaceous, pubescent on both surface, covering with short brown hairs on lamina and densely short brown hairs on midrib and main veins, venation partly anastomosing to form areoles with included free veinlets, veinlets free, simple, without free veinlets in costal and costular areoles. *Sori* round, terminal on included free veinlets, arranged in two rows between main veins; indusia round-reniform, thin, dorsifixed, persistent. **Fig. 4.25.**

Thailand.— NORTH-EASTERN: Loei (Tali); EASTERN: Chaiphaphum (Phu Khiao Wildlife Sanctuary), Nakhon Ratchasima (Khao Yai National Park); CENTRAL: Nakhon Nayok (Khao Yai National Park); SOUTH-EASTERN: Chantaburi (Khao Soi Dao Wildlife Sanctuary, Makham), Trat (Khlong Kaeo Waterfall National Park); SOUTH-WESTERN: Kanchanaburi (Khao Laem National Park, Khao Nan Ya, Nong Pling Waterfall, Sai Yok, Song Tho, Sangkhla Buri, Thong Pha Phum, Wangka), Phetchaburi (Kaeng Krachan National Park), Prachuap Khiri Khan (Hua Hin); PENINSULAR: Ranong (Khao Sai Daeng, Thunggraya-Nasak Wildlife Sanctuary), Surat Thani (Khlong Phanom National Park), Phangnga (Khao Nang Hong, Khao Ta Pae, Takua Pa), Phuket (Khao Phra Thaeo Wildlife Sanctuary), Krabi (Khao Phanom Benja National Park), Nakhon Si Thammarat (Khao Luang National Park, Khao Nan National Park), Trang (Khao Ao Khuan), Phatthalung (Khao Chai Son), Satun (Thale Ban National Park), Songkhla (Ton Nga Chang Wildlife Sanctuary), Yala (Bannang Sata, Betong, Than To), Narathiwat.

Distribution.— Bangladesh [Sylhet (type)], Myanmar, Vietnam, China (Taiwan), Malesia [Peninsular Malaysia, Singapore, Sumatra, Java, Borneo, Sulawesi, Philippines (Luzon, Leyte, Samar, Mindanao, Moluccas)].

Ecology.— Terrestrial in moist and shaded area on mountain slopes or limestone regions near stream banks in evergreen forest or somewhat in deciduous forest at 40–900 m alt.

Vernacular.— Kachot Raet (กะจอตแรต) (South-eastern).

Note.— This species had been a synonym of *T. griffithii* for decades. Ding et al. (2013) reexamined and published the revival of *T. multicaudata* as a correct name due to the difference of venation pattern. *T. multicaudata* has partly anastomosing venation to form costal and costular areoles, without or rarely included free veinlets. On the contrary, the fully anastomosing veins with free veinlets included in areoles

and costal and costular areoles inconspicuous is found in *T. griffithii*. Based on Thai specimen, I agree with the study of Ding et al. (2013).

It is noted that the holotype of *T. multicaudata* should be cited only the specimen with barcode K001080692 (*C.B. Clarke* 18427C). This is the specimen illustrated by Clarke (Trans. Linn. Soc. London, Bot. 1(8): 540, t. 77. 1880) with his original description of its basionym (*N. multicaudatum*). The other three type specimens [*C.B. Clarke* 18427B (K001080690), *C.B. Clarke* 18427F (BM), *C.B. Clarke* 18427H (K001080691)] should be proposed as paratypes of this species.

In addition, this species has two varieties, i.e. *T. multicaudata* var. *multicaudata* and *T. multicaudata* var. *amplissima* (Holtum) S.Y. Dong. *T. multicaudata* var. *amplissima* differs in its basal pinnae that have rather finely dissected fronds with up to six pairs of pinnules (Ding et al., 2013) and its distribution has been only in Sumatra and Moluccas.

Specimens examined.— **THAILAND:** Loei, Tali, ca 200 m, 25 Mar. 1924, A.F.G. Kerr 8809 (BK, BM, K); Kanchanaburi, Thong Pha Phum, 900 m, A. Sathapattayanon 101 (BCU); *ibid.*, A. Sathapattayanon 119 (BCU); Chaiyaphum, Phu Khiao Wildlife Sanctuary, A. Sathapattayanon 731 (BCU); Nakhon Si Thammarat, Khao Luang National Park, Krung Ching Waterfalls, 250 m, 9 Feb. 2001, B. Chusing et al. 5 (PSU); Trang, Khao Ao Khuan, 40 m, 18 Jan. 1966, B. Hansen and T. Smitinand 11989 (BKF); Yala, Than To, Than To village, 10 Dec. 1966, B. Sangkhachand 1408 (BKF); Yala, 6° 34' N 101° 18' E, 21 Oct. 1970, C. Charoenphol, K. Larsen & E. Warncke 4110 (BKF, K); Kanchanaburi, Sangkhla Buri, Lieuw Long Hill near Khao Ngai Yai, c 800–900 m, 4 Jan. 1968, C. F. van Beusekom & C. Phengkklai 252 (BKF, L); Ranong, Mueang Ranong, Khao Sai Daeng, c 400 m, 4 May 1968, C.F. van Beusekom & C. Phengkklai 553 (L); Kanchanaburi, Sangkhla Buri, Khao Laem National Park, Kra Teng Jeng Waterfall, 250 m, 23 Jan. 2009, D.J. Middleton, P. Karaket, S. Lindsay and S. Suddee 4759 (BKF); Surat Thani, Phanom, Khlong Phanom National Park, Trail from headquarters, 220 m, 26 Sep. 2010, D.J. Middleton, P. Karaket, S. Lindsay, T. Phutthai & S. Suddee 5548 (E, PSU, QBG); Trat, Bo Rai, Namtok Khlong Kaeo National Park, Than Hin Dat Waterfalls, 400 m, 8 Jan. 2009, D. J. Middleton, P. Karaket, S. Lindsay, T. Phutthai and S. Suddee 4642 (BKF, E); Surat Thani, Phanom, Khlong Phanom National Park, Trail from Park headquarters, 200 m, 7 Sep. 2008, D.J. Middleton, P. Triboun, V. Chamchumroon, S. Saengrit & R. Simma 4349 (BKF, E); Phetchaburi, Kaeng Krachan, Kaeng Krachan National Park, Through forest down behind Phanoen Thung ranger substation, 800 m, 13 May 2005, D.J. Middleton, C. Hemrat, S. Lindsay, S. Suddee & S. Suwanachat 3435 (BKF); Ranong, Kra Buri, Thungraya Nasak Wildlife Sanctuary, Along Bok Krai river from Wildlife Sanctuary headquarters, c 200 m, 28 Aug. 2002, D.J. Middleton, S. Suddee & C. Hemrat 1414 (BKF); Phetchaburi, Kaeng Krachan, Kaeng Krachan National Park, Track off road down from Khao Phanoen Thung ranger substation, 800 m, 15 Dec. 2002, D.J. Middleton, S. Suddee & C. Hemrat 1681 (BKF); Surat Thani, Phanom, Khlong Phanom National Park, Trail from headquarters around base of limestone mountain, c 100 m, 11 Apr. 2003, D.J. Middleton, S. Lindsay & R. Pooma 2121 (BKF, E, L); Phangnga, Mueang Phangnga, Khao Nang Hong, 300 m, 26 Jan. 1966, E. Hennipman 3742 (BKF, BM, L); Yala, Bannang Sata, 70 m, 27 Jul. 1923, E. Smith 1841 (K); Kanchanaburi, Sangkhla Buri, Wang Ka, 150 m, 3 Jun. 1946, G. den Hoed 919 (K, L); Kanchanaburi, Sangkhla

Buri, Muang Cha, 8 Jul. 1973, *J. F. Maxwell* 73-228 (BK); Chanthaburi, Khao Soi Dao Wildlife Sanctuary, 300 m, 12 May 1974, *J.F. Maxwell* 74-444 (BK); Yala, Than To, Than To Waterfalls Forest Park, 100 m, 12 Nov. 1986, *J.F. Maxwell* 86-900 (BKF, CMU, L, PSU); Nakhon Si Thammarat, Khanom, Khao Chai Son, *Jasan* 7031 (K); Nakhon Si Thammarat, Khao Luang National Park, c 500 m, 25 Aug. 1967, *K. Iwatsuki, H. Koyama, M. Hutoh & A. Chintayungkun* T-8510 (BKF, K, L); Satun, Khuan Don, Wang Prachan, Thale Ban National Park, 6°45' N 100°07' E, 100–150 m, 3 Oct. 1991, *K. Larsen, S.S. Larsen, C. Niyomdham, W. Ueachirakan & P. Sirirugsa* 42108 (BKF); Kanchanaburi, Thong Pha Phum, Song Tho, 700 m, 1 Feb. 1962, *K. Larsen & T. Smitinand* 9471 (BKF, L); Phangnga, Takua Pa, 200 m, 16 Jul. 1972, *K. Larsen, S.S. Larsen, I. Nielsen & T. Santisuk* 31044 (BKF, L); Nakhon Si Thammarat, Khao Luang National Park, 19 Feb. 1962, *Kyoji Yoda* 640 (BKF); *ibid.*, *Kyoji Yoda* 671 (BKF), Nakhon Si Thammarat, Khao Luang, interior of Wat Kiri Wong, 100–700 m, 17 Jan. 1966, *M. Tagawa, K. Iwatsuki & N. Fukuoka* T-4519 (BKF, E, L); Nakhon Si Thammarat, Lan Saka, SE side of Khao Luang National Park, Kamjan, 24 Mar. 1993, *P. Chantaranothai, D.J. Middleton, J. Parnell, D. Simpson & R. Simpson* 1416 (K); Nakhon Si Thammarat, Khanom, Khao Luang, 30 Jun 2011, *P. Nopsiriwong* 214 (BCU); Yala, Bannang Sata, Bo Hin Forest, 25 Nov. 1961, *P. S.* 1726 (BKF); Chanthaburi, Makham, Na-Ang, 720 m, 28 Jul. 1933, *Put* 333 (BKF); Yala, Banang Sata, 26 Jul. 1922, *Put for Eryl Smith* s.n. (K); Nakhon Si Thammarat, Khao Luang National Park, 26 Jul. 2014, *R. Pollawatn* 2118 (BCU); Sangkhla Buri, Wang Ka, 150 m, 21 May 1946, *S. Bloembergen* 611 (BK, K, L); Songkhla, Ton Nga Chang Wildlife Sanctuary, 250 m, 13 Aug. 1995, *S.S. Larsen, C. Tange, R. Moran, T. Niyomdham & P. Puudjaa* 45516 (BKF, K, L); Krabi, Mueang Krabi, Khao Phanom Bencha National Park, 22 Jul. 1982, *S. Sutisorn* 5300 (BK); Nakhon Nayok, Khao Yai National Park, Heaw Narok Waterfall, 8 Nov. 2014, *Sirisak W.* 083 (BCU); Narathiwat, Her Royal Highness Princess Sirindhorn Project, 150 m, 20 May 2002, *T. Boonkerd & R. Pollawatn* 249 (BCU); Yala, Betong, Dao Dueng Waterfall, 800 m, 24 Mar. 1993, *T. Boonkerd* 1164 (BCU); Yala, Than To, Than To Waterfalls Forest Park, 200 m, 25 May 1993, *T. Boonkerd* 1186 (BCU); Phangnga, Takua Pa, 430 m, 13 Aug. 1994, *T. Boonkerd* 1449 (BCU); *T. Boonkerd* 2322 (BCU); Kanchanaburi, Thong Pha Phum, Khao Nan Ya, 780 m, 11 May 2011, *T. Boonkerd et al.* 2011-122 (BCU); Phangnga, Mueang Phangnga, Kha Ta Pae, Tham Nam Phud, 17 May 2012, *T. Boonkerd et al.* 2011-563 (BCU); Nakhon Si Thammarat, Khao Nan National Park, Huai Lhek, 7 Apr. 2006, *T. Boonkerd, S. Chantanaorrapint & W. Khwaiphan* 71 (BCU); Yala, Than To, Than To Waterfalls Forest Park, 200 m, 9 Dec. 1972, *T. Santisuk & B.N.* 359 (BKF); *T. Smitinand* 1370 (BKF); Kanchanaburi, Sai Yok, Tao Dam Forest, 600 m, 20 Apr. 2002, *T. Vongthavone* 160 (BK, BKF); Phuket, Thalang, Khao Phra Thaeo Wildlife Sanctuary, 100–370 m, 14 Dec. 1979, *T. Shimizu, H. Toyokuni, H. Koyama, T. Yahara & C. Niyomdham* T-27212 (BKF, L); Prachuap Khiri Khan, Hua Hin, 356 m, 14 Jul. 2008, *V. Chamchumroon* VC2675 (BKF); Prachin Buri, Khao Yai National Park, Khao Khiao, 26 Dec. 2004, *W. Khwaiphan* 189 (BCU); Kanchanaburi, Thong Pha Phum, Pu Nong Pling, 26 Dec. 2004, *W. Khwaiphan* 201 (BCU);

**BANGLADESH:** *Sylhet*, *C.B. Clarke* 18427 (K), *G. Mann* 221 (K, P); **MYANMAR:** *Lobb* s.n. (K), *Parish* 86 (K); **VIETNAM:** *C.W. Chen* Wade1333, Wade1382, Wade1584 (TAIF); **CHINA:** *Taiwan*, *A. Henry* 192 (B), *B.J. Wang*



4173-B (TAIF), C.M. Kuo 13856 (TAI), C.W. Chen Wade792 (TAIF), P.F. Lu 10511, 17181, 26317, 26318, 28817, s.n. (TAIF), S.J. Yang 29847 (TAIF), T.C. Hsu 3651 (TAIF), U. Faurie 154 (B), Y.H. Chang 20080816-006 (TAIF); **MALESIA: Peninsular Malaysia**, A.G. Piggott 2780 (K), B.S. Parris, P.J. Edwards 10359, 10495 (K), C. Curtis 3404 (K), C.G. Matthew s.n. (K), Dr. King's Collector 2043, 2297 (K), Haniff & Nur 10224 (K), M. Nur s.n. (K), M.R. Henderson s.n. (K), P.J. Edwards 3504 (L), P.J. Edwards 3506 (K), P.J. Edwards 3670 (BKF, K), R.E. Holttum 24744 (K), R.H. Yapp 227 (K), Scortechini s.n. (K, P), Thomson s.n. (BKF), W. Norris s.n. (K); **Singapore**, C.G. Matthew s.n. (K), Dr. King's Collector 327 (K), House s.n. (K, P), R.E. Holttum 10480 (K); **Sumatra**, C.J. Brooks 23 (P), E. Gardette 375, 537 (K), J.A. Lörzing 11393 (K); **Borneo**, J. & M.S. Clemens 26845, 27329, 32065 (K), R.E. Holttum s.n. (K); **Sulawesi**, E. Hennipman 6117 (K, P); **Philippines**, Cuming s.n. (P), **Leyte**, C.A. Wenzel 9 (K), Cuming 310 (K); **Luzon**, Cuming s.n. (K), D.L. Topping 533 (K), Loher 858 (K, P), M. G. Price 953, 978, 1945 (K), Micholitz s.n. (K), M. Ramos 7556 (P), R. S. Williams 3 (K), T.E. Borden 24037 (K), Vidal s.n. (K), **Mindanao**, A.D.E. Elmer 11742 (K), C.A. Wenzel 2681 (K), C.M. Weber 1480 (K, P), D.O. Warburg s.n. (K); **Samar**, M.G. Price & B.F. Hernaez 401 (K); **Moluccas**, M. Kato, K. Ueda & U.W. Mahjar C-2193 (K), M. Kato, K. Ueda and Z. Fanani C-13214, C-13876, C-14114 (K).

**26. *Tectaria nayarii*** Mazumdar, Phytotaxa 158(3): 297. 2014. Type: Philippines, Mindanao, E.B. Copeland 1601 [holotype MICH! (photo seen MICH-1191022), photo K!].

*Stenosemia pinnata* Copel., Philipp. J. Sci. 1(suppl.2): 146. 1906; Alderw., Malayan Ferns: 727. 1908; Holttum, Gard. Bull. Singapore 9: 137. 1937; Copel., Fern Fl. Philipp.: 302. 1960. Type: as for *T. nayarii*.

*Heterogonium pinnatum* (Copel.) Holttum, Sarawak Mus. J. 5: 163. 1949; Revis. Fl. Malaya 2: 524, f. 307. 1955; Kalikasan 4: 229. 1975; Tagawa & K. Iwats., Fl. Thailand 3(3): 363, f. 33.8. 1988; Holttum, Fl. Males., Ser. 2, Pterid. 2: 115, f. 19d-f. 1991; I.M. Turner, Gard. Bull. Singapore 47(1): 52. 1995; Boonkerd & Pollawatn, Pterid. Thailand: 206. 2000; S. Linds., D.J. Middleton, Boonkerd & Suddee, Thai For. Bull., Bot. 37: 96. 2009. Type: as for *T. nayarii*.

*Rhizome* short, erect, bearing a tuft of fronds at apex; *scales* basifixed, concolorous, dark brown to castaneous, 5–8 × 1–1.5 mm, linear-lanceolate, apex acuminate, margin entire. *Fronde*s dimorphic, lamina bipinnatifid. *Sterile fronds*; stipes dark brown to castaneous, glossy, grooved, 14.0–45.0 cm long, covering with short brown hairs throughout, densely scaly at base; lamina ovate-subdeltoid, 18.0–30.0 × 14.0–24.0 cm; basal pinnae 9.0–16.0 × 3.0–8.0 cm, asymmetric, opposite, stalked, 0.4–0.6 cm long, lanceolate-elliptic, apex acuminate, base round to unequally cuneate, margin deeply lobed to 2/3 towards costa, lobes lanceolate-oblong, apex acute, margin entire, the lowest basal basisopic lobe reduced, mostly the shortest; lateral pinnae 1–3 pairs, 5.0–12.0 × 1.5–2.5 cm, shortly stalked at lower pinnae and sessile upwards, stalk 0.1–0.4 cm long, oblong-lanceolate-elliptic, sometimes falcate, apex acuminate, base round to subtruncate or fused with costa, margin deeply lobed to 1/2 towards costa, lobes oblong, apex acute, margin entire, gemmiferous bulbils on rachis sometimes present, interval 1.5–2.0 cm; terminal pinna 8.0–19.0 × 6.0–12.0 cm, ovate-subtriangular, apex acuminate, base cuneate, margin deeply lobed to 4/5

towards costa, lobes oblong-lanceolate, apex acute, margin entire to shallowly lobed; chartaceous, pubescent on both surface, densely hairy at rachis, costa and main veins, veins partly anastomosing forming costal areoles without free included veinlets, otherwise free, forked. *Fertile fronds*; stipes dark brown to castaneous, 28.0–60.0 cm long, covering with short brown hairs throughout, densely scaly at base; lamina much contracted, 10.0–24.0 × 5.0–8.0 cm, ovate-subdeltoid; basal pinnae 4.0–10.0 × 0.5–3.0 cm, opposite, shortly stalked, lanceolate-falcate, apex acuminate, base cuneate, margin deeply lobed to 1/2–2/3 towards costa, lobes lanceolate-falcate, apex acute, margin crenate, the lowest basal basisopic lobe reduced, mostly the shortest; lateral pinnae 1–4 pairs, alternate or opposite, 2.0–7.0 × 0.3–1.5 cm, lanceolate-falcate, apex acuminate, base cuneate or fused with costa, margin lobed, interval 1.0–3.0 cm; terminal pinna 4.0–10.0 × 3.5–5.5 cm, ovate-subdeltoid, apex acuminate, base cuneate, margin deeply lobed to 4/5 towards costa, lobes lanceolate-falcate, apex acute, margin subentire to crenate; chartaceous, pubescent on both surface, densely hairy at rachis, costa and main veins, veins all free, simple, pinnate. *Sori* confluent, elongate on veins or near margin or usually becoming to acrostichoid; exindusiate.

**Fig. 4.26.**

Thailand.— PENINSULAR: Ranong (La-un), Surat Thani (Phanom), Phangnga (Sra Nang Manora Forest Park), Krabi (Ao Luek, Khao Pra-Bang Khram Wildlife Sanctuary, Than Bok Khorani National Park), Nakhon Si Thammarat (Khao Luang National Park, Khao Nan National Park), Trang (Khao Pra-Bang Khram Wildlife Sanctuary), Phattalung (Khao Pu-Khao Ya National Park), Satun (Khuan Kalong), Songkhla (Saba Yoi), Yala (Bannang Sata).

Distribution.— Peninsular Malaysia, Sumatra, Borneo, Sulawesi, Philippines [Luzon, Mindanao (type)], Guam.

Ecology.— Terrestrial in shaded areas near stream banks in evergreen forest at 20–650 m alt.

Vernacular.— Pak kuai (ผักควาย) (Peninsular).

Uses.— Ornamental plants.

Note.— This species is very similar to *Tectaria stenosemioides* (Alderw.) C. Chr. in appearance but differing in its concolorous rhizome-scales and acrostichoid sporangia. An abnormal reduced form of fertile fronds could be observed in some specimens.

Specimens examined.— **THAILAND:** Nakhon Si Thammarat, Nopphitum, Khao Luang National Park, Krung Ching Waterfalls, 250 m, 9 Feb. 2001, *B. Chusing et al.* 6 (PSU); Krabi, Ao Luek, 8° 25' N 99° 45' E, 8 Oct. 1970, *C. Charoenphol, K. Larsen & E. Warncke* 3441 (BKF); Krabi, Khao Phra-Bang Khram Wildlife Sanctuary, c 80 m, 4 Apr. 1988, *C. Niyomdham & W. Ueachirakan* 1757 (BKF, L, P); Ranong, La-un, Ban Nai Wong, 10.031 N 98.841 E, 300 m, 19 Feb. 2006, *D.J. Middleton, C. Hemrat, S. Lindsay, S. Suddee & S. Suwanachat* 3832 (BKF); Surat Thani, Phanom, Khao Song Pee Nong, 8° 49.4' N 98° 41.7' E, 300 m, 21 Feb. 2001, *D.J. Middleton, K. Chayamarit, R. Pooma, V. Chamchumroon & K. Phattarahirankoonok* 550 (BKF); Trang, Wang Wiset, Ao Tong, Khao Phra-Bang Khram Wildlife Sanctuary, Roi Chan Phan Wang Waterfalls, 7.899 N 99.317 E, 200 m, 3 Jun. 2006, *D.J. Middleton, S. Lindsay, K. Phattarahirankoonok & S. Sirimongkol* 4089 (BKF, L); Phangnga, Mueang Phangnga, Sra Nang Manora Forest Park, 50 m, 16 Sep. 2010, *D.J. Middleton, K. Bunpha, P. Karaket, S. Lindsay, T. Phutthai, S.*

*Suddee & N. Tetsana* 5439 (PSU); Krabi, Ao Luek, Than Bok Khoranee National Park, 8° 23' 19" N 98° 44' 15" E, 15 m, 17 Sep. 2010, *D.J. Middleton, K. Bunpha, P. Karaket, S. Lindsay, T. Phutthai, S. Suddee & N. Tetsana* 5465 (PSU); Nakhon Si Thammarat, Khao Rum, 360 m, Feb. 1922, *E. Smith* 608 (K); Yala, Bannang Sata, 100 m, 26 Jul. 1923, *E. Smith* 1965 (K); Krabi, Khlong Thom, Khao Phra-Bang Khram Wildlife Sanctuary, 75–100 m, 8 Aug. 2006, *J.F. Maxwell* 06-537 (L); Satun, Khuan Kalong, Thung Nui, near Nam Ra Village, 200 m, 19 Aug. 1984, *J.F. Maxwell* 84-98 (BKF); Nakhon Si Thammarat, Tha Sala, Khao Luang National Park, Krung Ching Waterfalls, 325 m, 15 Dec. 1985, *J.F. Maxwell* 85-1128 (BKF, CMU, L, PSU); Phatthalung, Si Banphot, Khao Pu-Khao Ya National Park, between the headquarters and Mat Cha Cave, 225 m, 24 Sep. 1986, *J.F. Maxwell* 86-722 (PSU); Phangnga, Mueang Phangnga, Sra Nang Manora Forest Park, 8° 31' N 98° 33' E, 60 m, 23 Feb. 2001, *K. Chayamarit, R. Pooma, V. Chamchumroon, K. Phattarahirankanok, D.J. Middleton* 2685 (BKF); Nakhon Si Thammarat, Khao Luang National Park, 200–650 m, 25 Aug. 1967, *K. Iwatsuki, H. Koyama, M. Hutoh & A. Chintayungkun* T-8508 (BKF, L); Songkhla, Saba Yoi, Tham Ru Nok Sak, 6° 35' N 100° 50' E, 100 m, 21 Oct. 1991, *K. Larsen, S.S. Larsen, C. Niyomdham, W. Ueachirakan & P. Sirirugsa* 42481 (BKF, PSU); Krabi, Ao Luek, 8° 25' N 99° 15' E, 50 m, 23 Jul. 1972, *K. Larsen, S.S. Larsen, I. Nielsen & T. Santisuk* 31266 (BKF, P); Nakhon Si Thammarat, Tab Chang, 13 May 1954, *Phloenchit* 805 (BKF, K); Nakhon Si Thammarat, Khiriwong, Feb. 1959, *P. Suvanakoses* 515 (BKF, K, L); Yala, Bannang Sata, Bo Hin Forest, 29 Nov. 1961, *P. Suvanakoses* 1744 (BKF); Nakhon Si Thammarat, Khao Luang National Park, 7 Mar. 1962, *P. Suvanakoses* 1846 (BKF); Trang, Wang Wiset, Ao Tong, Roi Chan Phan Wang Waterfalls, Khao Phra-Bang Khram Wildlife Sanctuary, 10 Aug. 2005, *R. Pooma, K. Phattarahirankanok, S. Sirimongkol & M. Poopath* 5648 (BKF, L); Nakhon Si Thammarat, Khao Nan National Park, Huai Lhek, 13 Mar. 2006, *T. Boonkerd, S. Chantanaorrapint & W. Khwaiphan* 42 (BCU); *ibid.*, 18 Apr. 2006, *T. Boonkerd, S. Chantanaorrapint & W. Khwaiphan* 108 (BCU); Nakhon Si Thammarat, Khao Nan National Park, Tham Luang, 11 Jun. 2006, *T. Boonkerd, S. Chantanaorrapint & W. Khwaiphan* 224 (BCU); *ibid.*, 26 Jan. 2007, *T. Boonkerd, S. Chantanaorrapint & W. Khwaiphan* 411 (BCU); Krabi, Ao Luek, c 20 m, 19 Mar. 1960, *T. Smitinand & E.C. Abbe* 6576 (BKF, K);

**MALESIA: Peninsular Malaysia**, *A. Ernst* 1108 (K), *A.G. Piggott* 2950 (K), *B. Molesworth-Allen* 4822 (K), *B.S. Parris, P.J. Edwards* 10448 (K), *C.G. Matthew* s.n. (K), *Dr. King's Collector* 442, 5871 (K), *F.E.W. Venning* MA 115 (K), *H.J.* 481 (K), *H.N. Ridley* s.n. (K), *J. Sinclair* 40062 (K), *J. Sinclair & G.E. Edaño* 9847 (K, L), *K. Imin, A.R. Rafidah, R. Kiew, P. Wilkie, L.G. Saw* FRI 74608 (K), *M.R. Henderson* 19400, 25004 (K), *R. Kiew* RK 1411 (K), *R. Viane & Noë* 2324 (K), *S. Walthan et al.* 26 (K), *Scortechini* s.n. (K); **Sumatra**, *W.J.J.O. de Wilde and B.E.E. de Wilde-Duyffes* 12591, 20862 (L); **Borneo**, *B.S. Parris* 7050 (L), *J.J. Vermeulen* 1184 (L), *J.P. van Niel* 3570 (L), *Mohidin* S.21289 (K, L), *T.G. Walker* T13061 (K, L), *Veldkamp* 7873 (L), *Y.P. Ching* S.40178 (K, L); **Sulawesi**, *L. Joncheere* 1342 (L); **Philippines, Luzon**, *E.B. Copeland* 94 (L); **Mindanao**, *A.D.E. Elmer* 13468 (L); **GUAM**: *D. Anderson* 319 (L).

**27. *Tectaria phaeocaulis*** (Rosenst.) C. Chr., *Index Filic. Suppl.* 3: 183. 1934; Tagawa & K. Iwats., *S. E. Asian Stud.* 5: 98. 1967; C.E. DeVol & C.M. Kuo, *Fl.*

Taiwan 1: 344. 1975; C.M. Kuo, *Taiwania* 30. 29. 1985; Tagawa & K. Iwats., *Fl. Thailand* 3(3): 371. 1988; J.L. Tsai & W.C. Shieh, *Fl. Taiwan*, ed. 2: 300. 1994; Boonkerd & Pollawatn, *Pterid. Thailand*: 215. 2000; S.G. Lu & T.Y.A. Yang, *Taiwania* 50(2): 158. 2005; S. Linds., D.J. Middleton, Boonkerd & Suddee, *Thai For. Bull., Bot.* 37: 98. 2009; F.W. Xing, Y.H. Yan, S.Y. Dong, F.G. Wang, Christenh. & Hovenkamp, *Fl. China* 2–3: 741. 2013. Type: China, Taiwan, *U. Faurie* 33 [holotype S! (photo seen S-P-17520)].

*Aspidium phaeocaulon* Rosenst., *Hedwigia* 56: 345. 1915. Type: as for above.

*Tectaria laciniata* Ching, *Bull. Fan Mem. Inst. Biol.* 2: 200, t. 15. 1931; *Sinensia* 2(2): 24. 1931; C. Chr., *Index Filic., Suppl.* 3: 181. 1934; Tardieu & C. Chr., *Fl. Indo-Chine* 7(2): 414. 1941. Type: China, *C.G. Matthew* s.n. [lectotype (designated here) K! (K001080729), isolectotype K! (K001080730)].

*Aspidium laciniata* (Ching) Ching, *Bull. Fan Mem. Inst. Biol.* 10(5): 237. 1941. Type: as for *T. laciniata*.

*Sagenia variolata* sensu auctt. Nakai [non (Wall.) T. Moore, 1858], *Bot. Mag. Tokyo* 47: 168. 1933; Masumune, *Short Fl. Form.*: 29. 1936.

*Rhizome* short, creeping, densely scaly at apex; scales basifixed, bicolored, dark brown centrally with narrowly paler margin, 4–6 x 1–1.5 mm, linear-subtriangular, apex acuminate, margin hairy. Fronds monomorphic, bipinnate at base, bipinnatifid upwards; stipes castaneous to pale brown, dull, grooved adaxially, 22.0–40.0 cm long, covered with short hairs throughout, scaly at base; lamina oblong-oblong, 32.0–35.0 x 22.0–25.0 cm, basal pinnae 12.5–17.0 x 11.0–13.0 cm, stalked, stalk 1.8–2.0 cm long, ovate-lanceolate, deeply lobed; basal pinnule 12.0–14.0 x 3.0–3.5 cm, lanceolate-falcate, apex acuminate, base asymmetrically cuneate, margin deeply lobed to 1/2 towards costa, lobes oblong-falcate, apex acute to obtuse, margin entire, basal basispic lobes almost reduced; apical pinnule 4.5–5.5 x 1.5–2.0 cm, lanceolate, apex acute to acuminate, base round or fused to costa, margin subentire to crenate; terminal pinnule 14.0–18.0 x 7.5–10.0 cm, ovate-subtriangular, asymmetric, apex acuminate, base asymmetrically cuneate, margin deeply lobed to 4/5 towards costule, lobes oblong-lanceolate and falcate, apex acute to acuminate, margin entire to slightly crenate, basal basispic lobe of terminal pinnule usually the longest; lateral pinnae 3–4 pairs, stalked at lower pinnae and sessile upwards, stalk 0.3–1.0 cm long, 9.0–16.0 x 2.5–4.5 cm, lanceolate-falcate, apex acuminate, base asymmetrically round, margin deeply lobed to 1/2–2/3 towards costa, lobes oblong-falcate, apex acute to obtuse, margin entire; terminal pinna 12.0–15.5 x 6.5–11.0 cm, ovate-lanceolate, apex acute, base cuneate, margin deeply lobed to 4/5 towards costa, lobe lanceolate-falcate, apex acute to acuminate, subentire to irregularly crenate; papyraceous to chartaceous, glabrous on both surface except few short hairs on sinus, midrib and main veins, venation anastomosing forming irregular areoles with free included veinlets, veinlets free, simple or forked, costal areoles more or less having a few free included veinlets. Sori round, terminal on free included veinlets, arranged in two irregular rows between adjacent main veins; indusia round-reniform, thin, dorsifixed, persistent. **Fig. 4.27.**

Thailand.— NORTHERN: Chiang Rai (Doi Pacho), Lampang (Thoen), Phrae [Rong Kwang (Huai Rong)]; NORTH-EASTERN: Loei (Phu Kradueng National Park); EASTERN: Chaiyaphum (Phu Khiao Wildlife Sanctuary).

Distribution.— China [Yunnan, Guangxi, Hainan, Guangdong, Jiangxi, Fujian, Taiwan (Type)], Japan (Ryukyu Islands), Vietnam.

Ecology.— Terrestrial on mountain slope in mixed forest at 400–1,800 m alt.

Specimens examined.— **THAILAND:** Chaiyaphum, Phu Khiao Wildlife Sanctuary, *A. Sathapattayanon* 462 (BCU); *ibid.*, *A. Sathapattayanon* 488 (BCU); Chiang Rai, Doi Pacho (Doi Langka), 1,350–1,800 m, 27 Dec. 1965, *K. Iwatsuki & N. Fukuoka* T-3682 (BKF, L); Phrae, Rong Kwang, Huai Rong Waterfalls, 400 m, 9 Sep. 1995, 18° 20' N 100° 27 E, *K. Larsen, S.S. Larsen, C. Tange & D. Sookchaloem* 46228 (BKF); Lampang, Thoen, Along Highway 106 from Thoen to Li, 16 Jul. 2014, *R. Pollawatn* 1777 (BCU);

**CHINA:** *F.G. Wang* 5481 (K); **Guangdong,** *C.G. Matthew* s.n. (K), *H.Y. Liang* 60497 (BM); **Taiwan,** *C.C. Chang* 106 (TAI), *C.H. Yu, M.F. Kao, C.I. Hua* 462 (TAI), *C.M. Kuo* 332, 544, 954, 1433, 1536, 1840, 15732, s.n. (TAI), *C.S. Feung & M.T. Kao* 361 (TAI), *C.S. Kuoh* 2416, s.n. (TAI), *C.S. Li* 143 (TAI), *C.Y. Peng* 536, 1450 (TAI), *DeVol & Huang* 1233 (TAI), *Do* 176 (TAI), *E. Schuettpelz, M. Windham and H. Schneider* 1019C (BM), *E. Zogg & H. Gassner* 6105 (L), *H. Shimizu* 2975 (TAI), *H.Y. Chen* 1266 (TAI), *I. Simozawa* 177, 185, 186, 187, 760 (TAI), *K.J. Chien* 225 (TAI), *K. Mori* s.n. (TAI), *M.F. Kao* 1045, 3522, 3529, 3906 (TAI), *M.H. Huang* 125 (TAI), *M.L. Weng* 46 (TAI), *Mori* s.n. (TAI), *M. Tagawa* 2531 (BM), *M.T. Kao* 3409, 4073 (TAI), *R. Kanehira, S. Sasaki* s.n. (TAI), *S.F. Huang* 2932 (TAI), *S.H. Su* 1113 (TAI), *S. Hibino, S. Suzuki* s.n. (TAI), *S. Sasaki* s.n. (TAI), *S. Suzuki* 5811, 12275, 12277, 12279, 119311, s.n. (TAI), *Suzuki-Tokio* 8375, 10803, 19420 (TAI), *S.W. Fan* 5 (TAI), *T.C. Huang* 7616, s.n. (TAI), *T. Shimizu & M.T. Kao* 12339 (TAI), *T.Y. Chiang* 935, 949, 25916 (TAI), *U. Faurie* 33 (S), *U. Faurie* 34 (L), *Y.C. Liou* 1326, 1358 (TAI), *Y.F. Chen* 6455 (TAI), *Y.H. Chang* 981, 1868 (TAI), *Y.H. Chang* 4740 (BM), *Y.J. Lai, W.H. Wu et al.* 742 (TAI), *Y. Kudo* s.n. (TAI); **JAPAN: Ryukyu Islands,** *G. Koidzumi* s.n. (BM, L), *K. Suzuki* s.n. (L), *S. Kurata & T. Nakaike* 1907 (L), *Y. Saiki* 2308 (BM); **VIETNAM:** *B. Balansa* 1800 (K), *Cadiere* 24bis (BM), *Christensen* 4113 (BM), *Eberhardt* 399bis (P), *H. van der Werff, B. Gray, N.T. Hiep & N.S. Khang* 23765 (L), *P.A. Pételot* 350 (BM).

- 28. *Tectaria phanomensis*** *S. Linds.*, *Thai For. Bull., Bot.* 36: 49. 2008; *S. Linds.*, *D.J. Middleton, Boonkerd & Suddee*, *Thai For. Bull., Bot.* 37: 98. 2009. Type: Thailand, Surat Thani, Khlong Phanom National Park, *D.J. Middleton, S. Lindsay & R. Pooma* 2140 [holotype BKF! (SN 144201, SN 144202), isotypes A! (photo seen A00269865, A00269866)].

*Rhizome* short, erect, bearing a tuft of fronds at apex, densely scaly at apex; *scales* basifixed, concolorous, pale castaneous, 6–10 × 0.5–1 mm, lanceolate-subtriangular, apex acuminate, margin entire. *Fronde*s monomorphic, lamina bipinnatifid to bipinnate at base, bipinnatifid upwards; stipes brown to pale castaneous, dull, grooved, 21.0–50.0 cm long, covered with short hairs throughout, densely scaly at base; lamina triangular, 43.0–60.0 × 25.0–35.0 cm; basal pinnae 14.0–35.0 × 7.0–15.0 cm, alternate, stalked, stalk 0.5–3.0 cm long, lanceolate, deeply lobed; basal pinnule 6.0–16.0 × 1.0–3.0 cm, sessile to shortly stalked, lanceolate-falcate, apex acuminate, base truncate or fused with costule, margin deeply lobed to 1/2 towards costules, lobes lanceolate, apex acute to obtuse, margin entire; apical pinnule 1.5–5.0 × 0.3–1.5 cm, oblong-lanceolate, apex acute, base truncate or fused

with costule, margin slightly crenate; terminal pinnule 12.0–30.0 × 4.0–15.0 cm, asymmetric, ovate-subtriangular, apex acuminate, base asymmetrically cuneate, margin deeply lobed to 4/5 towards costule, lobes lanceolate-oblong, apex acute, margin entire to crenate, basiscopic lobes mostly longer than acroscopic lobes and basal basiscopic lobes the longest; lateral pinnae 3–6 pairs, alternate, stalked at lower pinnae and sessile upwards, stalks 0.1–0.5 cm long, 4.0–21.0 × 1.0–6.0 cm, lanceolate, apex acuminate, base asymmetrically cuneate, margin deeply lobed to 1/2 towards costa, lobes lanceolate-falcate, apex acute, margin entire, interval 4.0–6.0 cm; terminal pinna pinnatifid, 22.0–25.0 × 18.0–20.0 cm, ovate-subdeltoid, apex acuminate, base asymmetrically cuneate, margin lobed to 4/5 towards costa, lobe lanceolate, apex acuminate, margin entire to crenate; chartaceous, glabrous on both lamina surfaces except densely short hairs on midrib or main veins beneath, veins all free or mostly partly anastomosing forming costal areoles without free included veinlets, otherwise free, forked. *Sori* round, usually compital on free veins and sometimes terminal on free veins, arranged in two rows between main veins; exindusiate. **Fig. 4.28.**

Thailand.— PENINSULAR: Surat Thani (Khlung Phanom National Park).

Distribution.— Endemic.

Ecology.— Terrestrial at base of limestone cliffs in evergreen forest at 100–200 m alt.

Vernacular.— Kachot klong phanom (กะจอตคลองพนม).

Specimens examined.— **THAILAND:** Surat Thani, Phanom, Khlung Phanom National Park, Trail from Park headquarters, 8° 52' 33" N 98° 40' 31" E, 220 m, 26 Sep. 2010, *D.J. Middleton, P. Karaket, S. Lindsay, T. Phutthai & S. Suddee* 5552 (PSU); *ibid.*, 8° 52.4' N 98° 40.6' E, 200 m, 9 Jul. 2008, *D.J. Middleton, P. Triboun, V. Chamchumroon, S. Saengrit & R. Simma* 4362 (BKF, E); *ibid.*, 8° 53' N 98° 41' E, c 100 m, 11 Apr. 2003, *D.J. Middleton, S. Lindsay & R. Pooma* 2140 (A, BKF); *ibid.*, 27 Oct. 2007, *T. Boonkerd, Y. Sirichamorn & C. Sanguansab* 307 (BCU).

**29. *Tectaria poilanei*** Tardieu, Bull. Soc. Bot. France 87(2): 366–367, pl. 1, f. 3–4. 1940. Type: Vietnam, *Poilane* 24074 [holotype P! (photo seen P00644782), photo K! (K001084257)].

*Rhizome* short, erect, densely scaly at apex; *scales* basifixed, bicolored, castaneous to dark brown centrally with narrowly paler brown margin, 4–6 × 1–2 mm, ovate-lanceolate, apex acuminate, margin entire. *Fronde*s monomorphic, lamina unipinnate; stipes castaneous to dark glossy brown, grooved, 40.0–60.0 cm long, scaly at base; lamina 30.0–40.0 × 14.0–36.0 cm, oblong; basal pinnae 18.0–27.0 × 4.0–6.5 cm, stalked, stalks 0.1–1.0 cm long, elliptic-oblong, apex acuminate, base acute, margin entire, more or less having basiscopic lobe, basiscopic lobe 9.0–21.0 × 4.0–4.5 cm, elliptic, apex acuminate, margin entire; lateral pinnae 2–3 pairs, 10.0–17.0 × 2.5–4.5 cm, stipitate, stalks 0.1–0.5 cm long, elliptic-oblong, apex acuminate, base acute, margin entire to slightly crenate; terminal pinna simple, 12.5–21.0 × 4.5–6.0 cm, elliptic, apex acuminate, base cuneate, margin entire; chartaceous, glabrous on both surfaces except few short hairs on midrib or main veins beneath, veins fully anastomosing forming areoles with free included veinlets, veinlets usually forked, costal areoles having free included veinlets, sometimes forked. *Sori* round, dorsal on anastomosing veins or coupling veinlets, usually arranged in regular two zig-zag rows

between main veins; indusia round-reniform, peltate, brown, stiff, persistent. **Fig. 4.29.**

Thailand.— NORTHERN: Mae Hong Son [Pang Mapha (Doi Chong)], Chiang Mai (Khun Kaung San, Mae Wang); SOUTH-EASTERN: Chantaburi (Khao Soi Dao Wildlife Sanctuary).

Distribution.— Vietnam (type).

Ecology.— Terrestrial in shaded area on mountain slopes along stream in evergreen forest at 900–1,600 m alt.

Note.— Similar to *T. polymorpha* (Wall. ex Hook.) Copel. but differing in its venation pattern and sori.

Specimens examined.— **THAILAND:** Mae Hong Son, Pang Mapha, Doi Chong, 19° 25' N 98° 18' E, 1,420 m, 18 Feb. 1968, *B. Hansen and T. Smitinand* 12644 (BKF, E, K, L); Chiang Mai, Khun Kaung San, 1,600 m, 23 Jan. 1964, *B. Hansen, G. Seidenfaden & T. Smitinand* 10886 (BKF, L, K); Chantaburi, Khao Soi Dao Wildlife Sanctuary, c 13° N 102° 15' E, c 900–1,200 m, 13 Nov. 1969, *C.F. van Beusekom, T. Smitinand* 2193 (BKF, L); Chiang Mai, Mae Wang, Mae Win, Pha Dam Waterfalls, 1,275 m, 18 Mar. 2004, *J.F. Maxwell* 04-156 (BKF, CMUB);

**VIETNAM:** *Poilane* 24074 (K (photo), P).

**30. *Tectaria polymorpha*** (Wall. ex Hook.) Copel., Philipp. J. Sci., C 2: 413. 1907; C. Chr., Contr. U.S. Natl. Herb. 26: 330. 1931; Ching, Sinensia 2(2): 30. 1931; Tardieu & C. Chr., Fl. Indo-Chine 7(2): 417. 1941, p.p.; Dickason, Ohio J. Sci. 46(3): 121. 1946; Holttum, Dansk Bot. Ark. 23: 240. 1965, *pro parte, quoad F. Floto* 7699; K. Iwats., Acta Phytotax. Geobot. 25(2–3): 71. 1972; Sledge, Bot. J. Linn. Soc. 84: 18. 1982; C.M. Kuo, Taiwania 30. 29. 1985; Tagawa & K. Iwats., Fl. Thailand 3(3): 378, *pro parte*. 1988; Holttum, Fl. Males., Ser. 2, Pterid. 2: 87. 1991; J.L. Tsai & W.C. Shieh, Fl. Taiwan, ed. 2: 300. 1994; Boonkerd & Pollawatn, Pterid. Thailand: 215. 2000, *pro parte*; S.K. Wu, Acta Phytotax. Sin. 40(6): 533. 2002; S.G. Lu & T.Y.A. Yang, Taiwania 50(2): 158. 2005; S. Linds., D.J. Middleton, Boonkerd & Suddee, Thai For. Bull., Bot. 37: 98. 2009, *pro parte*; F.W. Xing, Y.H. Yan, S.Y. Dong, F.G. Wang, Christenh. & Hovenkamp, Fl. China 2-3: 741. 2013; J. Deepa, T.R. Parashurama, M. Krishanappa & S. Nataraja, Indian Fern J. 30: 18–24. 2013; Wardani & Jaenudin, Proc. Int. Conf. Resource Conservation: 182. 2013. Type: Nepal, *Wallich* 382 [lectotype (designated here) E! (photo seen E00499054), isoelectotypes B! (B 20 0168323), BM! (BM000543775, BM000543776, BM000543778), BR! (photo seen BR0000013306236), E! (photo seen E00499053, E00499055, E00499056), K!, PH! (photo seen PH00004809), US! (photo seen US00135268)].

*Aspidium polymorphum* Wall. ex Hook., Sp. Fil. [W.J. Hooker] 4: 54. 1862, excl. syn. *Aspidium repandum* Willd.; Bedd., Ferns S. India: 116. 1865; Handb. Ferns Brit. India: 218. 1883, all synonym excluded. Type: as for above.

*Aspidium nantoense* Hataya, Icon. Pl. Formosan. 8: 139–140, f. 63, f. 64. 1919. Type: China, Taiwan, *S. Fuji* s.n. (holotype TI, photo B!).

*Aspidium ternatense* Alderw., Bull. Dép. Agric. Ind. Néerl. 18: 9. 1908. Type: Ternate, *Teijsmann* s.n. (BO).

*Aspidium nudum* sensu auct. K.Schum. & Lauterb. [non (Baker) Diels, 1901], Fl. Schutzgeb. Südsee: 16. 1900.

*Tectaria crenata* sensu auct. Copel. (non Cav., 1802), Fern Fl. Philipp.: 312. 1960.

*Rhizome* short, erect to ascending, densely scaly at apex; *scales* basifixed, bicolored, castaneous to dark brown centrally with narrowly paler brown margin, 4–6 × 1–1.5 mm, linear-lanceolate, apex acuminate, margin toothed. *Fronde* monomorphic, unipinnate; stipes stramineous to pale dull brown, grooved, up to 55.0 cm long, covered with short hairs throughout, scaly at base, scales concolorous, dark brown, 4–7 × 1–1.5 mm, lanceolate-linear, apex acuminate, margin minutely toothed; lamina oblong-elliptic, 30.0–60.0 × 27.0–45.0 cm; basal pinnae 18.0–25.0 × 10.0–20.0 cm, stalked, stalk 0.5–1.5 cm long, opposite or subopposite, asymmetric, elliptic, sometimes falcate, apex acute to acuminate, base asymmetrically round, often having basisopic lobe; basal basisopic lobes 5.0–20.0 × 1.5–6.5 cm, elliptic, sometimes falcate, apex acute to acuminate, margin entire; lateral pinnae 2–3 pairs, shortly stalked at lower pinnae and sessile upwards, 20.0–25.0 × 5.0–8.0 cm, opposite or subopposite, elliptic-oblong, apex acute to acuminate, base oblique, margin entire, interval 8.0–9.5 cm; terminal pinna 18.0–30.0 × 7.0–20.0 cm, ovate-elliptic, apex acuminate, base acute to cuneate, margin entire or trilobed; chartaceous, pubescent on both surface, covering with short hairs throughout and densely hairy on midrib and main veins, veins fully anastomosing forming irregular areoles and areolules with free included veinlets, veinlets free, simple or forked, costal areoles having branched included veinlets. *Sori* round, dorsal on anastomosing veins, arranged in irregular 2–4 rows between main veins; indusia round-reniform, thin, brown, dorsifixed, caducous.

**Fig. 4.30.**

Thailand.— NORTHERN: Chiang Mai (Doi Suthep-Pui National Park), Tak (Doi Muser), Kamphaeng Phet (Mae Wong National Park); NORTH-EASTERN: Loei (Phu Hin Rong Kla National Park); EASTERN: Chaiyaphum (Phu Khiao Wildlife Sanctuary); SOUTH-WESTERN: Kanchanaburi (Sangkhla Buri, Thong Pha Phum), Prachuap Khiri Khan (Bang Saphan, Kaeng Krachan National Park); PENINSULAR: Chumphon (Khao Tong), Ranong (Lam Lieng), Phuket (Khao Phra Thaeo Wildlife Sanctuary).

Distribution.— Nepal, Bhutan, India (Sikkim, Assam, Karnataka, Kerala, Tamil Nadu), Bangladesh (Chittagong), Sri Lanka, China (Tibet, Yunnan, Guizhou, Guangxi, Hainan, Taiwan), Myanmar (Keng Tung, Moulmein, Tenasserim), Cambodia, Vietnam, Malesia [Java, Lombok, Philippines (Luzon)], Palau.

Ecology.— Terrestrial in shaded areas on mountain slopes in evergreen forest at 100–1,300 m alt.

Vernacular.— Kut kaeo (กูดแก้ว), kut taem (กูดแต่ม), kut kai (กูดไถ), kut hua lek (กูดหัวเหล็ก) (Northern); kut hok (กูดหก) (Shan/Northern); seng-khia-du (เซ็งเชียดู) (Karen/Northern).

Note.— It is closed to *Tectaria herpetocaulos* Holttum and *Tectaria poilanei* Tardieu in appearance but differing in rhizome, lamina surface and venation pattern. *T. polymorpha*, *T. poilanei* have erect to ascending rhizome whereas *T. herpetocaulos* has creeping rhizome. Sori distribution of *T. poilanei* arrange only two rows between main veins whereas *T. polymorpha* usually has 2–4 irregular rows of sori between main veins. It is noted here that some specimens from Sangkhla Buri district, Kanchanaburi province [C.F. van Beusekom & C. Phengklay 203 (B, BKF, K (photo),



L)] and Vicinity of Pilok, Thong Pha Phum district, Kanchanaburi province [*H. Koyama, F. Konta & W. Nanakhorn* T-48891 (BKF)] have densely yellow hairs on all parts of fronds.

Specimens examined.— **THAILAND:** Chumphon, Khao Tong, c 400 m, 18 Jan. 1927, *A.F.G. Kerr* 11555 (BK, K); Ranong, Lam Lieng, c 200 m, 2 Feb. 1927, *A.F.G. Kerr* 11780 (BM, K), Kanchanaburi, Thong Pha Phum, 500–1,000 m, 16 Jan. 2003, *A. Sathapattayanon* 115 (BCU); *ibid.*, 13 Jul. 2003, *A. Sathapattayanon* 226 (BCU); Chaiyaphum, Phu Khiao Wildlife Sanctuary, *A. Sathapattayanon* 670 (BCU); Kanchanaburi, Sangkhla Buri, Khao Yai, 15° 4' N 98° 37' E, 1,050 m, 29 Mar. 1968, *C.F. van Beusekom & C. Phengkklai* 203 (B, BKF, K (photo), L); Prachuap Khiri Khan, Bang Saphan, c 11° 10' N 99° 45' E, 12 Feb. 1970, *C.F. Beusekom, T. Santisuk* 2810 (L); Tak, Doi Muser Horticultural Research Station, c 800 m, 19 Nov. 1965, *E. Hennipman* 3057 (BKF, BM); Chiang Mai, Doi Suthep-Pui National Park, 18° 50' N 98° 55' E, c 1,000 m, 2 Jan. 1966, *E. Hennipman* 3516 (L); Tak, Ban Muser, between Tak and Mae Sot, c 400 m, 24 Jul. 1959, *F. Floto* 7699 (K); Chaiyaphum, Pha Khiao Wildlife Sanctuary, 16° 28' N 101° 45' E, 850–900 m, 7 Nov. 1984, *G. Murata, C. Phengkklai, S. Mitsuta, T. Yahara, H. Nagamasu & N. Nantasan* T-49595 (BKF); Kanchanaburi, Thong Pha Phum, Vicinity of Pilok, c 850 m, 1 Aug. 1985, *H. Koyama, F. Konta & W. Nanakhorn* T-48891 (BKF); Kanchanaburi, Thong Pha Phum, 901 m, *O. Vannasri* 23 (BCU); Loei, Dan Sai, Phu Hin Rong Kla National Park, the 5<sup>th</sup> tier of Man Daeng Waterfalls, 9 Jul. 2014, *Sirisak W. 002* (BCU); Kamphaeng Phet, Mae Wong National Park, Chong Yen, 1,300 m, 24 Oct. 2001, *S. Watthana* 1490 (QBG); *T. Boonkerd* 632 (BCU); *T. Boonkerd* 1374 (BCU); Phuket, Khao Phra Thaeo Wildlife Sanctuary, 100–370 m, 14 Dec. 1979, *T. Shimizu, H. Toyokuni, H. Koyama, T. Yahara & C. Niyomdham* T-27211 (BKF), Loei, Dan Sai, Phu Hin Rong Kla National Park, *W. Rattanathirakul* 125 (BCU); Tak, Doi Muser Horticultural Research Station, c 800 m, 4 Nov. 1984, *Y. Paisooksantivatana* y1477-84 (BK);

**NEPAL:** *A.H. Norkett* 7542 (BM), *A. Zimmermann* 1251 (BM), *C.R. Fraser-Jenkins* 1072, 1692 (BM), *C.R. Fraser-Jenkins, B. Pariyar, J.B. Pariyar, K. Neupane, R. Pariyar and R. Boruwal* 141 (BM), *C.R. Fraser-Jenkins, G. Pariyar* 1496 (BM), *C.R. Fraser-Jenkins, K. Neupane* 2013 (BM), *C.R. Fraser-Jenkins, R. Boruwal* 1880, 1881 (BM), *C.R. Fraser-Jenkins, Raj. Pariyar, Ram. Pariyar, R. Subedi* 1275 (BM), *H. Hara, H. Kanai, S. Kurosawa, G. Murata, M. Togashi & T. Tuyama* 7757 (BM), *H. Ohashi, H. Kanai, H. Ohba & Y. Tateishi* 771865 (BM), *Hook & Thomson* s.n. (K), *M. Mikage, T. Kajita, F. Kiuchi, N. Konda, P. Lacoul, M. Suzuki & K. Yonekura* 9558252 (L), *Wallich* 282 (B), *Wallich* 382 (B, BM, BR, E, K, PH, US), *Wallich* s.n. (B); **BHUTAN:** *F. Ludlow, G. Sherriff* 2996 (BM), *G. Murata, H. Ohashi, O. Tanaka & T. Yamazaki* 214 (BM), *Griffith* 2728, 2730 (K), *Griffith* s.n. (U), *H. Hara, H. Kanai, G. Murata, H. Ohashi, O. Tanaka & T. Yamazaki* 216 (BM), *R.E. Cooper* 1124 (BM); **INDIA:** **Sikkim,** *A. Meebold* 2022 (B), *Beddome* s.n. (K), *C.B. Clarke* 35450, s.n. (K), *C. K. 6/3* (K), *Dr. Jerdon* s.n. (B), *Dr. N.C. Nair* 52436 (K), *J.D.H.* s.n. (B, U), *J.S. Gamble* 5469A, 5470B, 8513 (K), *Raugbi* 547 (K), *R. Strachey and J.E. Winterbottom* 16 (K); **Assam,** *C.B. Clarke* 8995A (BM), *C.B. Clarke* 18907B, 19351 (K), *C.J. Simons* s.n. (BM), *E.J. Riddell* s.n. (K), *G. Mann* s.n. (L), *Griffith* s.n. (BM, K), *I. Warburgianum* 979 (B), *J.D.H. & J.J.* 224 (K), *J.F. Duthie* s.n. (K), *J.H. Wengler* 84, 99 (K), *M. Steele* 27 (K), *N.E. Parry* 610 (K), *Schlagintweit* 105 (B),

Wallich s.n. (BM); **Karnataka**, F.M. Jarrett, C. Saldanha HFP 762 (K); **Kerala**, A. Abraham 660 (K), F.M. Jarrett 659 (K), V.S. Manickam RHT 33068 (K); **Tamil Nadu**, Beddome 157 (K), Bourne 4909 (K), Hook. & J. Thomson 124 (K), Pulneep 6 (K), V.S. Manickam SJ 658 (K); **BANGLADESH: Chittagong**, J.J. s.n. (B); **SRI LANKA: Badulla** s.n. (BM), C.R. Fraser-Jenkins, B. Abey Siri, L. Abey Siri & A. Gunawardana 293 (K), F. Ballard 1041 (K), F. Ballard 1048, 1420, s.n. (K), F. Schmid 1077 (BM), Gardner 1094 (BM), Gardner 1096, 1377 (K), Griffith s.n. (K), G. Wall 44/211 (BM), Hutchinson 44/211 (B), J. Macrae 866pp (BM), T.G. Walker T98 (BM), Thwaites CP 1354 (B, BM), W.A. Sledge 527, 927 (L), W.A. Sledge 973 (K), W. Rawson Rawson 917 (BM), W. Robinson s.n. (K), Walker s.n. (K); **CHINA: Tibet**, South Tibet Expedition Team (STET) STET1888 (PE); **Yunnan**, A. Henry 12654, 12654A (B, K), C.W. Wang 74863, 77880, 78223 (PE), J. Cavalerie 2561, 7023 (K); **Guizhou**, J. Cavalerie 2561 (BM); **Taiwan**, A. Henry 1615 (K), C.C. Chen 3223 (TAI), C.E. DeVol 8167 (PH, TAI), C.H. Yu 185, 1008, 1104 (TAI), C.K. Liou 1283, 1620 (TAIF), C.S. Kuoh 4310, 4004 (TAI), C.W. Chen Wade880 (TAIF), C.M. Kuo 871, 924, 1869, 1911, 1924, 7423, 7728 (TAI), C.M. Kuo 13825 (B, TAI), E. Matsuda s.n. (TAI), H.N. Yang 1893 (TAI), H.C. Hung 511 (TAIF), Huang, Kou, Kao 782 (PH, TAI), H.Y. Chen 1267 (TAI), I. Simozawa 189, 190 (TAI), J.Y. Hwang, C.Y. Hwang 50 (TAI), M.L. Weng 1043, 1221 (TAI), M.F. Kao 2894, 3506 (TAI), M. Tagawa 1471 (K), M. Tagawa 2106 (BM), M.T. Kao 7464 (TAI), P.F. Lu 1787, 10523, 11289, 13408, 17277, 18273, 27952, s.n. (TAIF), S. Sasaki 380103, s.n. (TAI), Suzuki-Tukio 20880 (TAI), S. Yamada 19, 20 (TAI), T.C. Huang 1901 (TAI), T.C. Huang, S.F. Huang 15994 (TAI), T. Seiki 19, 82 (TAI), T.S. Liu et al. 34 (TAI), T.T. Chen 11764 (TAIF), T.Y. Yang 36, 55A, 96 (TAI), U. Faurie 8033, 8446 (TAI), U. Faurie 68 (L), Y.H. Chang 20070401-001, 20101229-013, 20111122-003, 20120708-011, 20120913-016, 20130817-003 (TAIF), Y.H. Chang 4533 (BM), Y.H. Chang 990, 991 (TAI), Y.S. Chao Chao815 (TAIF), Y. Simada 5408c (TAI), Y.T. Jeng s.n. (TAI); **MYANMAR: Keng Tung**, J.F. Rock 1954, 2084, 2130 (BM); **Moulmein**, C. Parish s.n. (BM, K); **Tenasserim**, G. Gullatly 287 (B); **CAMBODIA: E. Smith** 2695 (K); **VIETNAM: A. Pételot** 5205 (BM), L. Pierre s.n. (K), M. E. Colani 3398 (BM); **MALESIA: Peninsular Malaysia**, H.B. 2456 (L); **Java**, I. Mousset 143 (BM), S.H. Koorders 36095 $\beta$  (L); **Philippines, Luzon**, A.D.E. Elmer 22074 (B, BM, L), M.G. Price 879 (BM); **PALAU: P. Raymondus** 261, 346 (B).

**31. *Tectaria remotipinna*** Ching & Chu H. Wang, Acta Phytotax. Sin. 19: 129. 1981; S. Linds., D.J. Middleton, and Suksathan, Thai For. Bull., Bot. 41: 39. 2013. — Type: China, Yunnan, Jingdong, Wuliang Shan, W.X. Xu 59 [holotype PE! (photo seen PE00044751), photo K!].

*Tectaria viridifrons* Ching & Chu H. Wang, Acta Phytotax. Sin. 19: 130. 1981, as 'viridifrons'. — Type: China, Yunnan, Jingdong, B.Y. Qiu 52625 [holotype PE! (photo seen PE00044754)].

*Rhizome* short, erect or ascending, densely scaly at apex and present in rosette at apex; *scales* basifixed, bicolored, dark brown centrally with paler margin, usually arranged in rosette at apex, 5–10 × 0.5–1 mm, linear-lanceolate, apex acuminate, margin entire. *Fronde*s monomorphic, tripinnate to quadripinnatifid at base, bipinnatifid to tripinnatifid upwards; stipes stramineous to pale brown, shiny, grooved, 11.0–115.0 cm long, covered with short hairs throughout, swollen and scaly

at base, blunt spines present at base; lamina ovate-subdeltoid, 60.0–105.0 × 45.0–85.0 cm, basal pinnae bipinnate, 13.0–60.0 × 6.0–40.0 cm, stalked, stalk 2.0–5.0 cm long, ovate-lanceolate, deeply lobed; basal basisopic pinnule 15.0–21.0 × 7.0–9.0 cm, lanceolate-falcate, apex acuminate, base asymmetrically cuneate, margin deeply lobed to 2/3 towards costule, lobes lanceolate, apex acuminate, margin lobed; upper pinnule 3 pairs, 5.0–7.0 × 2.0–5.0 cm, alternate, lanceolate, apex acuminate, base cordate to cuneate or fused to costule, margin deeply lobed to 2/3 towards costule, lobes lanceolate, apex acute, margin crenate to lobed; terminal pinnule 12.0–25.0 × 7.0–12.0 cm, ovate, apex acuminate, base asymmetrically cuneate, margin deeply lobed to 4/5 towards costule, lobes lanceolate, apex acute to acuminate, margin slightly crenate to lobed; lateral pinnae 1–7 pairs, stalked at lower pinnae and sessile upwards, stalks 0.5–3.0 cm long, 21.0–46.0 × 9.0–24.0 cm, lanceolate-falcate, interval 9.0–14.0 cm; lateral pinnules 3–4 pairs, 4.0–13.0 × 1.5–4.5 cm, lanceolate, apex acuminate, base cordate to cuneate, margin lobed to 1/2 towards costule, lobes lanceolate, apex obtuse, margin crenate to shallowly lobed; terminal pinnules 12.0–20.0 × 6.0–18.0 cm, ovate, apex acuminate, base asymmetrically cuneate, margin deeply lobed to 4/5 towards costule, lobes lanceolate, apex acute to acuminate, margin slightly crenate to lobed; ultimate segment 18.0–25.0 × 15.0–20.0 cm, ovate, apex acuminate, base asymmetrically cuneate, margin deeply lobed to 4/5 towards costule, lobes lanceolate, apex acute to acuminate, margin slightly crenate to lobed; papyraceous to chartaceous, pubescent on both surface covering with short brown hairs throughout, venation anastomosing forming areoles with free included veinlets, veinlets free, simple, free veinlets in costal and costular areoles absent. *Sori* round, terminal on free included veinlets, arranged in two irregular rows between adjacent main veins in each lobe, slightly sunken, position of sori raised on lamina above; indusia round-reniform, thin, dorsifixed, persistent. **Fig. 4.31.**

Thailand.— NORTHERN: Chiang Mai (Chiang Dao Wildlife Sanctuary, Doi Inthanon National Park, Doi Pha Hom Pok National Park, Doi Suthep-Pui National Park, Mae Chaem, Mon Chong), Kamphaeng Phet (Mae Wong National Park).

Distribution.— Bhutan, China [Yunnan (type)].

Ecology.— Terrestrial or growing in rock crevices in moist and shaded areas on mountain slopes near stream banks in hill evergreen forest at 1,075–1,900 m alt.

Note.— This species is similar to *Tectaria coadunata* (Wall. ex Hook. & Grev) C. Chr. but differing in the present of rosette-arranged scales on its rhizome apex and stipe base.

Specimens examined.— **THAILAND:** Chiang Mai, Chom Tong, Doi Inthanon National Park, 2 km to Ban Khun Wang, 18° 37' 9" N 98° 30' 51" E, 1,450 m, 20 Sep. 2009, *D.J. Middleton, S. Lindsay & P. Suksathan* 4929 (E); Chiang Mai, Mae Chaem, Doi Pha Ti Do, near summit, 18° 45' 14" N 98° 6' 54" E, 1,400 m, 22 Sep. 2009, *D.J. Middleton, S. Lindsay & P. Suksathan* 4957 (E, QBG); Chiang Mai, Doi Inthanon National Park, 1,750 m, 19 Dec. 1965, *E. Hennipman* 3430 (BKF, L); Chiang Mai, Doi Suthep-Pui National Park, 1,450 m, 23 Aug. 2002, *J.F. Maxwell* 02-280 (CMUB); *ibid.*, 1,075 m, 29 Oct. 1988, *J.F. Maxwell* 88-1256 (BKF, CMU); *ibid.*, 1,025 m, 26 Jul. 1989, *J.F. Maxwell* 89-942 (CMU, L); Chiang Mai, Chiang Dao Wildlife Sanctuary, 1,400–1,800 m, 5 Jan. 1966, *M. Tagawa & K. Iwatsuki* T-4398 (BKF, L); Kamphaeng Phet, Mae Wong National Park, 16° 5' N 99° 4' E, 1,300 m, 22 Aug. 1995, *Parnell, Pendry, Jebb & Pooma* 95-380 (BKF); Chiang Mai, Doi

Inthanon National Park, beside road to Siriphoom Waterfalls, 1 Oct. 2014, *R. Pollawatn* 2149 (BCU); *ibid.*, *R. Pollawatn* 2150 (BCU); Chiang Mai, Fang, Doi Pha Hom Pok National Park, c 1,900 m, 23 Jan. 2015, *Sirisak W.* 088 (BCU); Chiang Mai, Om Koi, along road side about 8 km from Mon Jong, 1,400 m, 13 Oct. 1992, *T. Boonkerd* 1044 (BCU, K);

**BHUTAN:** *F. Ludlow & G. Sherriff* 2941A (BM); **CHINA: Yunnan,** *A. Henry* 10341B (B, K), *A. Henry* 10341C (B), *B.Y. Qiu* 52625 (PE), *K. Iwatsuki*, *H. Hara*, *S. Kurosawa*, *H. Ohashi*, *S. Mitsuta*, *M. Zang*, *S.K. Wu*, *X. Cheng*, *K.Y. Guan*, and *Y. Fei* 9, 633 (BM), *W.X. Xu* 59 (PE).

**32. *Tectaria rockii*** C. Chr., *Contr. U.S. Natl. Herb.* 26: 331. 1931; Tardieu & C. Chr., *Fl. Indo-Chine* 7(2): 420. 1941; Dickason, *Ohio J. Sci.* 46(3): 121. 1946; Holttum, *Dansk Bot. Ark.* 23: 238. 1965; Tagawa & K. Iwats., *S. E. Asian Stud.* 5: 98. 1967; *Fl. Thailand* 3(3): 374. 1988; Boonkerd & Pollawatn, *Pterid. Thailand*: 216. 2000; S.K. Wu, *Acta Phytotax. Sin.* 40(6): 538. 2002; S. Linds., D.J. Middleton, Boonkerd & Suddee, *Thai For. Bull., Bot.* 37: 98. 2009; F.W. Xing, Y.H. Yan, S.Y. Dong, F.G. Wang, Christenh. & Hovenkamp, *Fl. China* 2-3: 742. 2013. Type: Thailand, Tak, between Palut and Nam Dip, on the trail from Raheng (Tak) to Mesawt (Mae Sot), *J.F. Rock* 668 [holotype C! (photo seen C10020611), isotypes NY! (photo seen NY00128137), US! (photo seen US00135269)].

*Aspidium rockii* (C. Chr.) Ching, *Bull. Fan Mem. Inst. Biol., Bot.* 10(5): 237. 1941. Type: as for *T. rockii*.

*Tectaria burmanica* Ching, *Sinensia* 2(2): 31, pl. 12. 1931. Type: Myanmar, N Shan States, *J.H. Lacey* 4857 [holotype K! (K001080674), isotype K! (K001080673)].

*Tectaria grossedentata* Ching & Chu H. Wang, *Acta Phytotax. Sin.* 19(1): 127. 1981; F.W. Xing, Y.H. Yan, S.Y. Dong, F.G. Wang, Christenh. & Hovenkamp, *Fl. China* 2-3: 738. 2013. Type: China, Yunnan, *Yunnan Complex Exped.* 759 [holotype PE! (photo seen PE00044741), paratype *Yunnan Complex Exped.* 967 PE! (photo seen PE00044740)].

*Tectaria kweichowensis* Ching & Chu. H. Wang, *Acta Phytotax. Sin.* 19(1): 128. 1981. Type: China, Guichou, *S.W. Deng* 1655 [holotype PE! (photo seen PE00044748), isotype PE! (photo seen PE00044747)].

*Tectaria linloensis* Ching & Chu. H. Wang, *Acta Phytotax. Sin.* 19(1): 128–129. 1981; C.M. Kuo, *Taiwania* 30. 29. 1985. Type: China, Guangxi, *R.C. Ching* 4618 (GXU 70) [holotype PE! (photo seen PE00044749), paratype *R.C. Ching* 6714 PE! (photo seen PE01454565)].

*Tectaria yunnanensis* sensu auctt Holttum [non (Baker) Ching, 1931], *Dansk Bot. Ark.* 23: 240. 1965, *pro parte, quoad K. Larsen* 9498; Tagawa & K. Iwats., *Fl. Thailand* 3(3): 372, *in adnot.*

*Rhizome* short, erect to ascending, densely scales at apex; scales basifixed, concolorous, brown, 5–12 x 1–1.5 mm, linear-lanceolate, apex acuminate, margin entire. *Fronde*s monomorphic, bipinnatifid to quadripinnatifid at base and bipinnatifid to tripinnatifid upwards; stipes stramineous to light brown adaxially, deeper brown and grooved abaxially, 13.5–103.0 cm long, covered with short brown hair throughout abaxially, scaly at base; lamina 30.0–80.0 x 22.0–50.0 cm, ovate-subtriangular in

outline; basal pinnae 20.0–42.0 x 10.0–30.0 cm, opposite, ovate-lanceolate in outline, deeply lobed; basispic pinnule 8.0–15.0 x 2.0–5.0 cm, stalked at lower pinnules and sessile upwards, stalk 0.2–0.3 cm, lanceolate, apex acuminate, base round to cuneate, margin deeply lobed to 1/4–1/2 towards costule, lobes lanceolate-triangular, apex acute, margin entire; acroscopic pinnule 3.0–13.0 x 1.5–5.0 cm, shortly stalked to sessile, lanceolate, apex acuminate, base round to truncate, margin subentire; terminal pinnule 17.0–31.0 x 9.0–27.0 cm, ovate-lanceolate, apex acuminate, base unequally cuneate, margin deeply lobed to 3/5–4/5 towards costule, lobes lanceolate-triangular, apex acuminate, margin subentire to irregularly crenate, basispic lobes longer than acroscopic lobes; lateral pinnae 1–2 pairs, 13.0–24.0 x 3.5–15.0 cm, opposite or subopposite, usually bipinnatifid and sometimes bipinnate, stalked at lower pinnae and sessile upwards, stalk 0.5–0.8 cm, lanceolate-falcate, apex acuminate, base unequally cuneate, margin lobed, gradually narrowing from base towards apex, lobes lanceolate-triangular, apex acuminate, margin subentire, interval 10.0–13.0 cm, basal pinnules 6.0–24.0 x 1.5–2.0 cm, sessile, lanceolate, apex acuminate, base truncate, margin subentire to crenate; terminal pinna pinnatifid, 20.0–28.0 x 17.0–27.0 cm, ovate-subtriangular, apex acuminate, base cuneate, margin deeply lobed to 4/5 towards costa, lobes lanceolate-falcate, gradually narrowing from base towards apex, apex acuminate, margin subentire to shallowly lobed; chartaceous, glabrous on both surface except a few short hairs on midrib and main veins, veins anastomosing forming areoles and areolules with free included veinlets near costa, otherwise free, forked near margin, lateral main veins twisted, veinlets simple or branched, costal areoles having free included veinlets, veinlets usually branched. *Sori* round, terminal at coupling veinlets near margin or dorsal on anastomosing veins, in irregular rows between adjacent lateral veins, usually confined to lobes; indusia round-reniform, brown, stiff, persistent. **Fig. 4.32.**

Thailand.— NORTHERN: Chiang Mai (Chiang Dao Wildlife Sanctuary, Om Koi, Pong Pho), Chiang Rai (Doi Luang National Park, Doi Tung), Lampang (Doi Luang National Park), Phrae (Huai Rong), Tak [Doi Musoe, Huay Hin Daeng Waterfall, Tak to Mae Sot (type), Namtok Pha Charoen National Park, Lan Sang National Park]; NORTH-EASTERN: Loei (Phu Luang Wildlife Sanctuary); SOUTH-EASTERN: Chonburi (Ban Bueng, Si Racha), Chantaburi (Khao Soi Dao Wildlife Sanctuary); SOUTH-WESTERN: Uthai Thani (Ban Rai, Hup Pa Tat), Kanchanaburi (Chaloem Rattana Kosin National Park, Dong Yai, Erawan National Park, Song Tho, Thong Pha Phum); PENINSULAR: Chumphon (Bang Son).

Distribution.— China (Yunnan, Guizhou, Guangxi, Hainan, Taiwan), Myanmar, Laos (Laotien), Vietnam.

Ecology.— Terrestrial on moist ground or growing in crevices on limestone bedrocks by streams in shady area in dense evergreen forest or mixed deciduous forest at 100–1,500 m alt.

Vernacular.— Kachot Raet (กะจอตแรต) (South-western).

Note.— *T. grossedentata* is firstly synonymized into *T. rockii* in this study.

Specimens examined.— **THAILAND:** Loei, Phu Luang, c 17° N 101° 40' E, c 950 m, 18 Jan. 1970, *C.F. van Beusekom*, *C. Phengkklai* 3058 (BKF, K); Kanchanaburi, Erawan National Park, 14° 17' N 99° 15' E, 400 m, 20 Nov. 1971, *C.F. van Beusekom*, *C. Phengkklai*, *R. Geesink*, *B. Wongwan* 3896 (BKF); Phrae, Rong Kwang, Huai Rong, 18° 7' N 100° 9' E, 200 m, 1 Jun. 1972, *C.F. van Beusekom*, *C.*

*Phengkklai*, R. *Geesink*, B. *Wongwan* 4696 (BKF); Chanthaburi, Khao Soi Dao Wildlife Sanctuary, 13° N 102° 15' E, c 400 m, 11 Oct. 1969, *C.F. van Beusekom*, T. *Smitinand* 2100 (BKF, K); Kanchanaburi, Dong Yai, 700 m, 14 Aug. 1971, *CP*, *BN*, *BS* 2955 (BKF); Chanthaburi, Khao Soi Dao Wildlife Sanctuary, 13° 4' 9" N 102° 10' 1" E, 550 m, 13 Jan. 2009, *D.J. Middleton*, *P. Karaket*, *S. Lindsay*, *T. Phutthai* & *S. Suddee* 4700 (QBG); Tak, Lan Sang National Park, 16° 50' N 99° 5' E, c 400 m, 18 Nov. 1965, *E. Hennipman* 3032 (BKF); Tak, Doi Muser Horticultural Experimental Station, 16° 45' N 99° E, c 800 m, 19 Nov. 1965, *E. Hennipman* 3052 (B, BKF); Loei, Phu Luang Wildlife Sanctuary, 17° 25' N 101° 25' E, c 950 m, 1 Aug. 1966, *E. Hennipman* 3537 (B, BKF); Kanchanaburi, Erawan National Park, c 150 m, 10 Oct. 1971, *G. Murata*, *K. Iwatsuki* & *D. Chaiglom* T-16180 (BKF, K); Chonburi, Ban Bueng, Ang Chang Nam, 350 m, 2 Sep. 1975, *J.F. Maxwell* 75-959 (BK); Chonburi, Si Racha, Khao Kheow, 800 m, 15 Feb. 1976, *J.F. Maxwell* 76-110 (BK, L); Chiang Mai, Chiang Dao Wildlife Sanctuary, 550 m, 22 Jan. 1989, *J.F. Maxwell* 89-84 (CMU); Lampang, Wang Nuea, Doi Luang National Park, 575 m, 21 Apr. 1997, *J.F. Maxwell* 97-360 (BKF); Tak, between Palut and Nam Dip, on the trail from Raheng (Tak) to Mesawt (Mae Sot), 17–18 Dec. 1920, *J. F. Rock* 668 (NY, US); Kanchanaburi, Chaloe Ratthana Kosin National Park, along trail from headquarter to Trai Trueng Waterfalls, 28 Nov. 2008, *Kanchana* s.n. (BKF); Uthai Thani, Ban Rai, Kaen Pra Doo, 600 m, 1 May 1963, *Kasem* 366 (BK); Chanthaburi, Khao Soi Dao Wildlife Sanctuary, 700–1,525 m, 8–9 Feb. 1966, *K. Iwatsuki* & *N. Fukuoka* T-7178 (BKF); Chiang Rai, Doi Tung, en route from Ban Huai Khrai to Wat Doi Tung, 600 m, 24 Sep. 1967, *K. Iwatsuki*, *N. Fukuoka*, *M. Hutoh* & *D. Chaiglom* T-11010 (BKF, E); Kanchanaburi, Huai Mae Nam Kwae Noi, 250 m, 2 Jan. 1962, *K. Larsen* 9098 (K); Kanchanaburi, Erawan National Park, 200–300 m, 25 Jan. 1962, *K. Larsen* 9273 (BKF, K); Kanvahnaburi, Song Tho, 800 m, 2 Feb. 1962, *K. Larsen* 9498 (K); Kanchanaburi, Erawan National Park, 14° 20' N 99° 55' E, 100–300 m, 7 Jan. 1974, *K. Larsen* & *S.S. Larsen* 33963 (BKF); Chiang Mai, Pong Pho, 12 km N of Chiang Dao Wildlife Sanctuary, 800 m, 8 Jan. 1968, *K. Larsen*, *T. Santisuk* & *E. Warncke* 2993 (BKF, E, L); Loei, Phu Luang Wildlife Sanctuary, 1,100–1,500 m, 4 Dec. 1965, *M. Tagawa*, *K. Iwatsuki* & *N. Fukuoka* T-1276 (BKF, K); Chiang Mai, Chiang Dao Wildlife Sanctuary, 500–600 m, 9 Nov. 1967, *M. Tagawa*, *T. Shimizu*, *M. Hutoh*, *H. Koyama*, & *A. Nalampoon* T-9751 (BKF, K); Chumphon, Bang Son, 12 Sep. 1927, *Put* 1675 (BK); Chiang Mai, Chiang Dao, Tham Pha Thong, c 300 m, 13 Aug. 1995, *R. Pooma* 1057 (BKF); Chiang Rai, Phan, Doi Luang National Park, Pu Kaeng Waterfalls, 5 Dec. 2015, *S. Wongphakdee* 2015-1 (BCU); Kanchanaburi, Erawan National Park, 100–300 m, 11 Mar. 1979, *T. Shimizu*, *H. Toyokuni*, *H. Koyama*, *T. Yahara* & *C. Niyomdham* T-21601 (BKF); Chanthaburi, Khao Soi Dao Wildlife Sanctuary, 300–800 m, 28 Nov. 1979, *T. Shimizu*, *H. Toyokuni*, *H. Koyama*, *T. Yahara* & *D. Phanichaphol* T-23906 (BKF); Chiang Mai, Om Koi, from Mae Tuen Watershed Improvement Station to Nang Kruan Waterfalls, 950–1,100 m, 18 Oct. 1979, *T. Shimizu*, *H. Toyokuni*, *H. Koyama*, *T. Yahara* & *T. Santisuk* T-19151 (BKF); Tak, Phop Phra, Namtok Pha Charoen National Park, 600 m, 31 Jul. 1993, *T. Boonkerd* 1204 (BCU); *T. Boonkerd* 1572 (BCU); Kanchanaburi, Thong Pha Phum, Lung Lerd Falls, 13 May 2011, *T. Boonkerd et al.* 2011-179 (BCU); Uthai Thani, Hoob Pa Tad, 25 May 2013, *T. Boonkerd et al.* 2011-743 (BCU); Chiang Mai, 600 m,

3 Sep. 1965, *T. Smitinand* 8685 (BKF); Chiang Mai, Chiang Dao Wildlife Sanctuary, 430–440 m, 11 Aug. 1922, *Winit* 969 (BKF);

**CHINA: Yunnan**, *Yunnan Complex Exped.* 759, 967 (PE), **Guichou**, *S.W. Deng* 1655 (PE), **Guangxi**, *R.C. Ching* 4618 (GXU 70), 6714 (PE); **MYANMAR: F.G. Dickason F208 (BM), *F.G. Dickason* 9288 (BM), *J.H. Lace* 4857 (K); **LAOS: Laotien**, *Poilane* 2174 (BM, P), *Poilane* 2408 (P); **VIETNAM: B. Balansa 57bis, 1800bis (P), *Colani* 2745 (BM, P), *Colani* 2747 (P), *Colani* 2748 (BM), *Colani* 3389, 3393 (P), *L. Cadiere* 10, 1149 (P), *M.R.P. Cadière* 1086 (P).****

**33. *Tectaria sagenioides*** (Mett.) Christenh., *Phytotaxa* 10: 58. 2010; F.W. Xing, Y.H. Yan, S.Y. Dong, F.G. Wang, Christenh. & Hovenkamp, *Fl. China* 2–3: 743. 2013. Type: Java, *Zollinger* 1803 [lectotype Z (*n.v.*), photo K! (K000421760)]. *Aspidium sagenioides* Mett., *Abh. Senckenberg. Naturf. Ges.* 2(4): 397. 1858; *Farngett.* 4: 113. 1858; *Racib.*, *Pteridop. Buitenzorg*: 179. 1898. Type: as for above.

*Dryopteris sagenioides* (Mett.) Kuntze, *Revis. Gen. Pl.*: 813. 1891; Christ, Philipp. J. Sci. 2 Bot.: 211. 1907; Alderw., *Malayan Ferns*: 191. 1908; Backer & Posth., *Varenfl. Java*: 41. 1939. Type: as for *A. sagenioides*.

*Ctenitopsis sagenioides* (Mett.) Ching, *Bull. Fan Mem. Inst. Biol.* 8: 312. 1939; Dickason, *Ohio J. Sci.* 46(3): 121. 1946. Type: as for *A. sagenioides*.

*Heterogonium sagenioides* (Mett.) Holttum, *Sarawak Mus. J.* 5: 161. 1941; Holttum, *Rev. Fl. Malaya* ed. 1, 2: 520, f. 306. 1955 [‘1954’], p.p.; *Reinwardtia* 3: 271. 1955 [‘1954’]; *Kalikasan* 4: 211. 1975; Tagawa & K. Iwats., *Fl. Thailand* 3(3): 362. 1988; Holttum, *Fl. Males.*, Ser. 2, *Pterid.* 2: 108. 1991; I.M. Turner, *Gard. Bull. Singapore* 47(1): 53. 1995; Boonkerd & Pollawatn, *Pterid. Thailand*: 207. 2000; Newman et al., *Checkl. Vasc. Pl. Lao PDR*: 32. 2007; S. Linds., D.J. Middleton, Boonkerd & Suddee, *Thai For. Bull.*, Bot. 37: 96. 2009. Type: as for *A. sagenioides*.

*Ctenitis sagenioides* (Mett.) Copel., *Gen. Fil.*: 124. 1947; *Fern Fl. Philipp.*: 295. 1960. Type: as for *A. sagenioides*.

*Nephrodium melanopus* Hook., *Sp. Fil.* 4: 110. 1862, excl. pl. Ambon. Type: Myanmar, Moulmein, *Parish* 51 [holotype K! (K001080788)].

*Lastrea melanopus* (Hook.) Bedd., *Ferns Brit. India*: t. 38. 1865. Type: as for *N. melanopus*.

*Polypodium obscurum* Hook., *Sp. Fil.* 4: 237. 1862, non Mett., 1857; Alderw., *Malayan Ferns*: 492. 1908. Type: Philippines, Leyte, *Cuming* 302 [holotype K! (K000427782), isotypes K! (K000427783, K000427784)].

*Phegopteris obscura* (Hook.) Christ, *Bull. Herb. Boissier* 6: 196. 1898. Type: as for *P. obscurum*.

*Nephrodium obscurum* (Hook.) Diels in Engl. & Prantl, *Nat. Pflanzenfam.* I, 4: 173. 1899. Type: as for *P. obscurum*.

*Dryopteris sagenioides* (Mett.) Kuntze subsp. *obscura* C. Chr., *Index Filic.*: 290. 1905. Type: as for *P. obscurum*.

*Dryopteris obscura* (Hook.) Christ, Philipp. J. Sci. 2 Bot.: 214. 1907. Type: as for *P. obscurum*.

*Ctenitopsis obscura* (Hook.) C. Chr., *Notul. Syst. (Paris)* 7: 87. 1938. Type: as for *P. obscurum*.

- Heterogonium obscurum* (Hook.) Holttum, *Kalikasan* 4: 218, f. 1. 1975. Type: as for *P. obscurum*.
- Polypodium viscosum* C.H. Wright, *Kew Bull.*: 12. 1906. Type: Vietnam, Lao-kai, E.H. Wilson 36 [holotype K! (K001080786)].
- Dryopteris laokaiensis* C. Chr., *Index Filic. Suppl.* 1: 34. 1913. Type: as for *P. viscorum*.
- Phegopteris schizoloma* Alderw., *Bull. Jard. Bot. Buitenzorg* II, 16: 24. 1914; *Malayan Ferns, Suppl.*: 306. 1917. Type: E Borneo, *Amdjah* 595 [BO, photo K! (K000421761)].
- Dryopteris schizoloma* (Alderw.) C. Chr., *Index Filic. Suppl.* 2: 16. 1917. Type: as for *P. schizoloma*.
- Dryopteris sagenioides* var. *gurupahensis* C. Chr., *Svensk Bot. Tidskr.* 16: 95, f. 2. 1922. Type: Sulawesi, *Kaudern* 18 [lectotype (designated here) S! (photo seen S-P-10859), isolectotype BM! (BM001048664), paralectotypes *Kaudern* 17 S! (photo seen S09-42942, S09-42943, S-P-5084)].
- Dryopteris gurupahense* (C. Chr.) C. Chr., *Bot. Jahrb. Syst.* 66: 45. 1934. Type: as for *D. sagenioides* var. *gurupahensis*.
- Heterogonium gurupahense* (C. Chr.) Holttum, *Reinwardtia* 3: 272. 1955; Tagawa & K. Iwats., *S. E. Asian Stud.* 5: 99. 1967; Holttum, *Rev. Fl. Malaya*, ed. 2, 2: 636. 1968; K. Iwats., *Amer. Fern J.* 63(3): 131. 1973; Tagawa & K. Iwats., *Fl. Thailand* 3(3): 361, f. 33.6 & 33.7. 1988; Boonkerd & Pollawatn, *Pterid. Thailand*: 206. 2000; Newman et al., *Checkl. Vasc. Pl. Lao PDR*: 32. 2007; S. Linds., D.J. Middleton, Boonkerd & Suddee, *Thai For. Bull., Bot.* 37: 96. 2009. Type: as for *D. sagenioides* var. *gurupahensis*.
- Stenosemia aurita* sensu auct. Hook. [non (Sw.) C. Presl, 1836], *Gen. Fil.*: t. 94, for f. 5 & 6 only. 1842.
- Aspidium membranifolium* sensu auct. (C. Presl) Kunze, *Bot Zeit. (Berlin)* 6: 261. 1848.
- Phegopteris philippinensis* sensu auct. (Fée) Mett., *Farngett.* 4: 26, for var. 2 only. 1858.
- Heterogonium teysmannianum* sensu auct. Holttum, *Reinwardtia* 1: 29. 1950, *pro parte, quoad Cuming* 302.
- Ctenitis obscura* sensu auct. (Hook.) Copel., *Fern Fl. Philipp.*: 287. 1960, *pro parte, quoad Cuming* 302.

*Rhizome* short, erect, densely scaly at apex; *scales* basifixed, bicolored, dark brown at central portion with ferruginous margin, 2–4 × 1.0–1.5 mm, ovate-lanceolate, apex acuminate, margin hairy. *Fronde*s monomorphic, lamina bipinnatisect; stipes deep castaneous to nearly black, rarely greenish, glossy, grooved, 34.0–42.0 cm long, covered with short hairs throughout, scaly at base; lamina elliptic, (13.0–)24.0–38.0 × 11.0–22.0 cm; basal pinnae usually not longer than upper ones, 5.0–15.0 × 3.0–6.0 cm, shortly stalked, subopposite, elliptic-oblong, often falcate, apex acuminate, base round to subtruncate, margin pinnatisect to 4/5 towards costa, lobes oblong, apex acute, margin entire to serrate, the lowest basal basispic lobe reduced, mostly the shortest; lateral pinnae 3–9 pairs, alternate to subopposite, shortly stalked at lower pinnae and sessile upwards, 6.0–14.0 × 1.5–3.5 cm, oblong-oblong and slightly falcate, apex acuminate, base round to subtruncate, margin pinnatisect to 4/5 towards costa, lobes oblong-falcate, apex acute, margin entire to slightly crenate,



interval 2.5–4.5 cm; terminal pinna 9.0–14.0 × 5.0–10.0 cm, lanceolate-ovate, apex acuminate, base cuneate, margin deeply lobed to 4/5 towards costa, lobe lanceolate-oblong, sometimes falcate, apex acute, margin entire to crenate; herbaceous to papyraceous, pubescent on both surface, covering with unicellular brown hairs on lamina and 3-celled brown hairs densely on rachis, costae, main veins and margin of lamina, veins all free, 6–8 pairs in each lobe of pinnae, elongate to margin. *Sori* round, terminal on short acroscopic branches of veinlets, arranged in 2 rows between main veins; indusia round-reniform, peltate, caducous. **Fig. 4.33.**

Thailand.— NORTHERN: Chiang Rai, Phitsanulok (Thung Salaeng Luang National Park); NORTH-EASTERN: Phetchabun (Khao Ko), Loei (Phu Kradueng National Park); EASTERN: Chaiyaphum (Phu Khiao Wildlife Sanctuary), Nakhon Ratchasima (Khao Yai National Park); CENTRAL: Nakhon Nayok (Khao Yai National Park); SOUTH-EASTERN: Rayong (Khao Chamao-Khao Wong National Park, Khao Yai Da), Chantaburi (Khao Khitchakut National Park, Khao Sabap, Khao Soi Dao Wildlife Sanctuary, Makham), Trat (Bo Rai, Ko Chang); SOUTH-WESTERN: Kanchanaburi (Sai Yok, Thong Pha Phum), Phetchaburi (Kaeng Krachan National Park), Prachuap Khiri Khan (Huai Yang Waterfall National Park); PENINSULAR: Ranong (Kapoe, Khlong Nakha Wildlife Sanctuary, Laem Son National Park, Thungraya Nasak Wildlife Sanctuary), Surat Thani (Bandon, Khao Sok National Park), Phangnga (Khao Kata Lawan, Khao Phra Mi), Phuket (Khao Kluay), Nakhon Si Thammarat (Khao Luang National Park, Khao Nan National Park), Trang (Khao Chong, Phu Pha Mek), Yala (Than To), Narathiwat (Siridhorn Waterfalls).

Distribution.— India, China (Yunnan, Guangxi, Hainan), Myanmar (Moulmein, Tavoy), Laos, Vietnam, Malesia [Peninsular Malaysia, Sumatra, Java (type), Borneo, Sulawesi, Philippines (Luzon, Leyte, Negros, Mindanao, Sulu Archipelago)].

Ecology.— Terrestrial on mountain slopes in deep shaded areas in dense evergreen forest from near sea level to 1,600 m alt.

Vernacular.— Nera Po Si (นระโพศรี) (South-Eastern).

Note.— According to Flora of Thailand (Tagawa and Iwatsuki, 1988), this species was published in the genus *Heterogonium* and was separated into two species by using the different kind of hairs (one or two types) on lamina, i.e. *H. gurupahense* (C. Chr.) Holttum, and *H. sagenioides* (Mett.) Holttum. Later, Holttum (1991b) reported that *H. gurupahense* was the misapplied name for plants only in Malaya and Thailand. In this study, I agree with Holttum's study and it is noted here that *H. gurupahense* should be included in *H. sagenioides* and was transferred into genus *Tectaria*.

Specimens examined.— **THAILAND:** Trat, Ko Chang, 100 m, 3 Apr. 1923, A.F.G. Kerr 6538 (BK); Trat, Bo Rai, c 600 m, 30 Nov. 1924, A.F.G. Kerr 9507 (BK); Ranong, c 100 m, 14 Jan. 1929, A.F.G. Kerr 16663 (BK); Phangnga, c 900 m, 9 Mar. 1930, A.F.G. Kerr 18483 (BK); Kanchanaburi, Thong Pha Phum, 800–900 m, 20 Jul. 2002, A. Sathapattayanon 1 (BCU); *ibid.*, 21 Jul. 2002, A. Sathapattayanon 47 (BCU); *ibid.*, 15 Jan. 2003, A. Sathapattayanon 100 (BCU); *ibid.*, 16 Mar. 2003, A. Sathapattayanon 129 (BCU); Chaiyaphum, Phu Khiao Wildlife Sanctuary, A. Sathapattayanon 625 (BCU); *ibid.*, A. Sathapattayanon 726 (BCU); *ibid.*, A. Sathapattayanon 842 (BCU); Phangnga, Khao Phra Mi, 100 m, 7 Jan. 1966, B.

*Hansen and T. Smitinand* 11823 (BKF); Trat, Ko Chang, 12° 3' N 102° 33' E, 0–50 m, 18 Nov. 1970, *C. Charoenphol, K. Larsen & E. Warncke* 5001 (BKF); Narathiwat, Sirindhorn Waterfalls, 100 – 150 m, 23 Dec. 1999, *C. Phengklai et al.* 14917 (BKF); Phetchaburi, Kaeng Krachan, Kaeng Krachan National Park, Trail from near Khao Phanoen Thung Ranger substation towards KU Camp on Phetchaburi River, 12° 51.2' N 99° 18.2' E, 450 m, 27 Mar. 2003, *D.J. Middleton, C. Hemrat, S. Lindsay, S. Suddee & S. Suwanachat* 1740 (BKF); *ibid.*, On trail to Thor Thip Waterfalls, 12.845 N 99.320 E, 500 m, 11 May 2005, *D.J. Middleton, C. Hemrat, S. Lindsay, S. Suddee & S. Suwanachat* 3386 (BKF); Surat Thani, Phanom, Khao Sok National Park, 8.920 N, 98.604 E, 230 m, 26 Feb. 2006, *D.J. Middleton, C. Hemrat, S. Lindsay, S. Suddee & S. Suwanachat* 4021 (BKF); Yala, Than To, Ban Chulaphon Phatthana 7, 130 m, 9 Feb. 2004, *D.J. Middleton, M. Phuphat, R. Pooma & K. Williams* 2844 (BKF); Trat, Ko Chang, Thammagon Waterfalls, 155 m, 5 Jan. 2009, *D.J. Middleton, P. Karaket, S. Lindsay, T. Phutthai and S. Suddee* 4601 (BKF); Ranong, Kra Buri, Thungraya Nasak Wildlife Sanctuary, Along Bok Krai River from Wildlife Sanctuary headquarters, 10° 23' N 98° 52' E, 250 m, 30 Jan. 2004, *D.J. Middleton, R. Namdang, R. Pooma, S. Suddee, S. Suwanachat, K. Williams* 2722 (BKF); Trang, Yan Ta Khao, Khao Banthat Mountains, trail to summit of Phu Pha Mek, c 600 m, 8 Apr. 2003, *D.J. Middleton, V. Chamchamroon, S. Lindsay, R. Pooma & S. Suwanachat* 2037 (BKF); Phuket, Thalang, Khao Kluay, 8° N 98° 20' E, c 80–220 m, 24 Jan. 1966, *E. Hennipman* 3722 (BKF, L, P); Nakhon Si Thammarat, Khao Luang National Park, 8° 30' N 99° 45' E, c 625 m, 3 Feb. 1966, *E. Hennipman* 3797 (B, BKF, L); Trat, Ko Chang, near sea level, 2 Aug. 1973, *G. Murata, N. Fukuoka & C. Phengklai* T-17476 (BKF); Chanthaburi, Khao Soi Dao Wildlife Sanctuary, c 200–300 m, 5 Aug. 1973, *G. Murata, N. Fukuoka & C. Phengklai* T-17761 (BKF, K); *ibid.*, *G. Murata, N. Fukuoka & C. Phengklai* T-17767 (BKF); Chanthaburi, Khao Khitchakut National Park, Kra Ting Waterfalls, 21 Oct. 1972, *J.F. Maxwell* 72-459 (BK); Chanthaburi, Makham, Ban Ang, 200 m, 13 Aug. 1973, *J.F. Maxwell* 73-426 (BK); Chanthaburi, Khao Soi Dao Wildlife Sanctuary, 300 m, 12 May 1974, *J.F. Maxwell* 74-452 (BK); *ibid.*, 1,000 m, 7 May 1974, *J. F. Maxwell* 74-660 (BK, L); Ranong, Kaper, Lam Son National Park, 100 m, 29 Nov. 1996, *J.F. Maxwell* 96-1566 (CMUB, L); Nakhon Si Thammarat, Khao Luang National Park, 750 m, 24 Aug. 1967, *K. Iwatsuki, H. Koyama, M. Hutoh & A. Chintayungkun* T-8445 (BKF, L); *ibid.*, *K. Iwatsuki, H. Koyama, M. Hutoh & A. Chintayungkun* T-14643 (BKF, L); Nakhon Ratchasima, Khao Yai National Park, 400 m, 11 Aug. 1968, *K. Larsen, T. Santisuk & E. Warncke* 3312 (BKF, L); Phangnga, Khao Phra Mi, 9° 17' N 98° 26' E, 60 m, 9 Jul. 1972, *K. Larsen, S.S. Larsen, I. Nielsen & T. Santisuk* 30821 (BKF, P); Chanthaburi, Khao Sabap, 21 Aug. 1966, *K. Larsen, T. Smitinand & E. Warncke* 1628 (BKF); Phetchaburi, Kaeng Krachan, Kaeng Krachan National Park, Trail from Panoen Thung camp to Pa Kluay Mai Waterfalls, 12° 50' 28" N 99° 18' 29" E, 460 m, 28 Jan. 2005, *K. Williams, S. Suddee, C. Hemrat, N. Rithphet, S. Polphan* 1154 (E, L); Nakhon Si Thammarat, Khao Luang National Park, 19 Feb. 1962, *K. Yoda* 598 (BKF); *ibid.*, *K. Yoda* 622 (BKF); Phitsanulok, Thung Salaeng Luang National Park, 500 m, 3 Oct. 1967, *M. Tagawa* T-11787 (BKF); Nakhon Si Thammarat, Khao Luang National Park, 100–700 m, 17 Jan. 1966, *M. Tagawa, K. Iwatsuki & N. Fukuoka* T-4517 (BKF, L); *ibid.*, c 700 m, 22 Jan. 1966, *M. Tagawa, K. Iwatsuki & N. Fukuoka* T-5302 (BKF, L); Trang, Khao Chong, 600–1,100 m, 27 Jan. 1966, *M. Tagawa, K.*

*Iwatsuki & N. Fukuoka* T-6808 (BKF, L); *ibid.*, 100–600 m, 28 Jan. 1966, *M. Tagawa, K. Iwatsuki & N. Fukuoka* T-6981 (BKF); Phetchabun, Khao Kho, Kaeng Ratchapruerk, *Nachol T.* 30 (BCU); *ibid.*, *Nachol T.* 45 (BCU); *ibid.*, *Nachol T.* 50 (BCU); *ibid.*, *Nachol T.* 70 (BCU); Nakhon Si Thammarat, Khao Nan National Park, Sunantha Waterfalls, 100 m, 12 Jun. 2006, *O. Ratana* 57 (BCU); Loei, Phu Kradueng National Park, *P. Jadprajong* 27 (BCU); *ibid.*, *P. Jadprajong* 50 (BCU); Nakhon Si Thammarat, Khao Luang National Park, 600 m, 29 Oct. 1951, *P. Suvanakoses* 124 (BKF); Chanthaburi, Makham, 23 Jul. 1933, *Put* 323 (BKF); Nakhon Si Thammarat, Khao Luang National Park, 25 Jul. 2014, *R. Pollawatn* 2018 (BCU); *ibid.*, *R. Pollawatn* 2115 (BCU); Nakhon Nayok, Khao Yai National Park, 14° 26' N 101° 22' E, 796 m, 26 May 2000, *S. Chongko* 76 (BKF); Chanthaburi, Khao Yai Da, 28 May 1994, *T. Boonkerd* 1428 (BCU); Nakhon Si Thammarat, Khao Nan National Park, 1 Oct. 2006, *T. Boonkerd, S. Chantanaorrapint & W. Khwaiphan* 490 (BCU); *ibid.*, 21 Jul. 2007, *T. Boonkerd, S. Chantanaorrapint & W. Khwaiphan* 426 (BCU); *ibid.*, 23 Jul. 2007, *T. Boonkerd, S. Chantanaorrapint & W. Khwaiphan* 489 (BCU); *ibid.*, *T. Boonkerd, S. Chantanaorrapint & W. Khwaiphan* 490 (BCU); *ibid.*, 8 Oct. 2007, *T. Boonkerd, Y. Sirichamorn & C. Sanguansab* 146 (BCU); *ibid.*, 11 Oct. 2007, *T. Boonkerd, Y. Sirichamorn & C. Sanguansab* 239 (BCU); Ranong, Kaper, Khlong Naka Wildlife Sanctuary, 30–50 m, 8 Dec. 1979, *T. Shimizu, H. Toyokuni, H. Koyama, T. Yahara & C. Niyomdham* T-26442 (BKF); Ranong, Kaper, Khao Pawta Luangkaeo, 300–600 m, 11 Dec. 1979, *T. Shimizu, H. Toyokuni, H. Koyama, T. Yahara & C. Niyomdham* T-26967 (BKF); Rayong, Khao Cha Mao-Khao Wong National Park, 50–650 m, 24 Nov. 1979, *T. Shimizu, H. Toyokuni, H. Koyama, T. Yahara & D. Phanichaphol* T-23527 (BKF, L); *ibid.*, *T. Shimizu, H. Toyokuni, H. Koyama, T. Yahara & D. Phanichaphol* T-23541 (BKF); *ibid.*, *T. Shimizu, H. Toyokuni, H. Koyama, T. Yahara & D. Phanichaphol* T-23542 (BKF); Chanthaburi, Khao Soi Dao Wildlife Sanctuary, 800–850 m, 26 Nov. 1979, *T. Shimizu, H. Toyokuni, H. Koyama, T. Yahara & D. Phanichaphol* T-23681 (BKF); Nakhon Si Thammarat, Khao Luang National Park, 600 m, 29 Oct. 1951, *T. Smitinand* 1016 (BKF); *ibid.*, 8 Nov. 1951, *T. Smitinand* 1050 (BKF); Chanthaburi, Khao Soi Dao Wildlife Sanctuary, c 800 m, 18 Feb. 1959, *T. Smitinand* 5513 (BKF); Kanchanaburi, Sai Yok, Tao Dam Forest, 500–600 m, 11 Aug. 2001, *T. Vongthavone* 085 (BK, BKF); Ranong, Kaper, 26 Apr. 1974, *Tippan* 105 (BK); Ranong, Ngao Waterfall National Park, 27 Apr. 1974, *Tippan* 123 (BK); Chiang Rai, 450 m, 14 Aug. 1923, *Winit* 1109 (BKF); Prachuap Khiri Khan, Huai Yang Waterfall National Park, 800 m, 13 Aug. 2000, *Y. Yuyen* 197 (BCU);

**INDIA:** *Burck* s.n. (L); **CHINA:** **Hainan**, *H. Fung* 20224 (K), *W.T. Tsang* 505 (K); **MYANMAR:** **Moulmein**, *C.S. Parish* 51, 57 (K); **Tavoy**, *C.S. Parish* s.n. (K), *J.F. Maxwell* 98-1107 (L); **VIETNAM:** **Colani** 1973 (P), *D.D. Soejarto* DDS\_13128 (L), *Poilane* 6340 (P), *Schmid* 213, 236, 313, s.n. (P), *V.N.* 172 (P), *Vietnam-America (VA) Series*, *N.T. Hiep, P.K. Loc, N.Q. Binh, T.T. Phuong & L. Xiem* 532 (P); **MALESIA:** **Peninsular Malaysia**, *A.G. Piggott* 2799, 2859, 2868, 3006 (K), *B. Molesworth-Allen* 4828 (K), *B.S. Parris, P.J. Edwards* 10387 (K, L), *C.G. Matthew* s.n. (K), *Dr. King's Collector* 529 (K), *Dr. King's Collector* 8742 (K, L), *Dr. King's Collector* 10779 (K), *Ernst* s.n. (K), *Griffith* 874 (P), *H.N. Ridley* 14194 (K), *Mactier* s.n. (K), *M. Haniff & Nur* 10204 (K), *M. Nur* 2039, 11542 (K), *Parris* 10387 (L), *P.J. Edwards* 3515 (BKF, L, P), *R.H. Yapp* 228 (K), *R. Jaman &*

Zainudin PL 52 (K), *Scortechini* s.n. (L); **Singapore**, *J. Sinclair* 40372 (K), *R.E. Holttum* 39450 (K, L); **Sumatra**, *A.H.G. Alston* 13875, 15213 (L), *E. Gardette* 374, 511 (K, L), *H. Beukema* HB 2213 (L), *J.S. Burley, Tukirin et al.* 1529 (L), *Korthals* 521, 832, s.n. (L), *W.J.J.O. de Wilde and B.E.E. de Wilde-Duyffjes* 20280 (L); **Java**, *Zollinger* 1601 (L), *Zollinger* 1803 [K (photo)]; **Borneo**, *Amdjah* 595 (K (photo)), *B.S. Parris* 10773 (K), *B.S. Parris, J.P. Croxall* 9002 (K), *J.P. Mogeia and W.J.J.O. de Wilde* MOGEA 3526 (L), *K. Iwatsuki, M. Kato, G. Murata & Y.P. Mogeia* B-405 (L), *K. Iwatsuki, M. Kato, G. Murata & Y.P. Mogeia* B-2125 (K, L); **Sulawesi**, *A.H.G. Alston* 16443 (L), *D. Joncheere* 1089, 1152, 1204 (L), *E. Hennipman* 5072 (L), *W. Kaudern* s.n. (K); **Philippines**, *Michoitz* s.n. (K); **Luzon**, *A.D.E. Elmer* 17230 (L), *A. Loher* 1129 (K), *M.G. Price* 976, 1885, 1914, 1938, 1943, 1967, 2034, 2206 (K); **Leyte**, *Cuming* 302 (K); **Negros**, *M.G. Price* 2504 (K); **Mindanao**, *A. Loher* 951 (K); **Sulu Archipelago**, *Y. Konda & G. Edaño* PNH 38693 (K).

**34. *Tectaria semipinnata*** (Roxb.) C.V. Morton, *Contr. U.S. Natl. herb.* 38: 286. 1974; *Holttum, Fl. Males., Ser. 2, Pterid.* 2: 67. 1991; *I.M. Turner, Gard. Bull. Singapore* 47(1): 55. 1995; *Boonkerd & Pollawatn, Pterid. Thailand:* 216. 2000; *S. Linds., D.J. Middleton, Boonkerd & Suddee, Thai For. Bull., Bot.* 37: 98. 2009. Type: Malaysia, Malay Islands, *Roxburgh* 2387 [holotype BM! (BM001048594)].

*Acrostichum semipinnatum* Roxb., *Calcutta J. Nat. Hist.* 4: 480. 1844. Type: as for above.

*Polypodium semipinnatum* Roxb., *Calcutta J. Nat. Hist.* 4: 486. 1844; C.V. Morton, *Contr. U.S. Natl. Herb.* 38: 360. 1974. Type: Malaysia, Malay Islands, *Roxburgh* 2396 [lectotype (designated here) BR! (photo seen BR0000006984960), isolectotype BR! (photo seen BR0000006985295)].

*Gymnogramme maingayi* Baker, *Syn. Fil.*: 517. 1874. Type: Malaysia, Malacca, *Maingay* 1809 [holotype K! (K000236462)].

*Selliguea maingayi* (Baker) Bedd., *Suppl. Ferns Brit. Ind.*: 24. 1876; *Handb. Ferns Brit. India:* 392. 1892. Type: as for *G. maingayi*.

*Polypodium maingayi* (Baker) Diels in *Engl. & Prantl, Nat. Pflanzenfam.* 1, 4: 318. 1899. Type: as for *G. maingayi*.

*Hemionitis maingayi* (Baker) Ridl., *J. Malayan Branch Roy. Asiat. Soc.* 4: 106. 1926. Type: as for *G. maingayi*.

*Aspidium maingayi* (Baker) *Holttum, Gard. Bull. Starits Settle.* 5: 207. 1934. Type: as for *G. maingayi*.

*Tectaria maingayi* (Baker) *C. Chr., Index Filic., Suppl. Tert.*: 182. 1934; *Holttum, Gard. Bull. Singapore* 9: 138. 1937; *Rev. Fl. Malaya* ed. 1, 2: 513, f. 302. 1955 [‘1954’]; *Holttum, Dansk Bot. Ark.* 20: 31. 1961; *Tagawa & K. Iwats., S. E. Asian Stud.* 3(3): 86. 1965; *ibid.* 5: 99. 1967; *Acta Phytotax. Geobot.* 23: 55. 1968; *K. Iwats., Amer. Fern J.* 63(3): 133. 1973; *A. Johnson, A Student’s Guide to the Ferns of Singapore Island:* 83. 1977; *Tagawa & K. Iwats., Fl. Thailand* 3(3): 382. 1988. Type: as for *G. maingayi*.

*Polypodium heterosorum* Baker, *Syn. Fil. ed. 2:* 506. 1874. Type: Malaysia, Malacca, *Pulo Bissar, W. Griffith* s.n. [holotype K! (K000236461), isotypes K! (K000236455, K000236456, K000236457, K000236458, K000236459, K000236460), L! (photo seen L 0822602)].

*Dictyopteris heterosora* (Baker) Bedd., Ferns Brit. India Suppl.: 20. 1876; Handb. Ferns Brit. India: 302. 1883. Type: as for *P. heterosorum*.

*Phegopteris subdecurrens* Luerss., Bot. Centralbl. 11: 30. 1892. Type: Singapore, Pulau Ubin, *F. Kehding* 2960 [holotype P! (photo seen P01631100), isotype BM! (BM001048595)].

*Aspidium subdecurrens* (Luerss.) C. Chr., Index Filic.: 94. 1905; Gard. Bull. Straits Settle. 4: 393. 1929. Type: as for *P. subdecurrens*.

*Campylogramma trollii* Goebel, Flora 125: 282, f. 1–4. 1931. Type: cult. München, Sumatra, Pulau Berhala, *W. Troll* s.n. [M, photo BM!].

*Tectaria polymorpha* sensu auct. Holttum [non (Wall. ex Hook.) Copel., 1907], Dansk Bot. Ark. 20: 31. 1961, *pro parte, quoad T. Sørensen, K. Larsen, and B. Hansen* 673.

*Rhizome* short, erect, scaly; *scales* basifixed, bicolored, dark brown to castaneous at central part with narrowly paler ferruginous edge, 7–10 x 2–3 mm, lanceolate, apex acuminate, margin minutely toothed. *Fronde*s dimorphic, fertile fronds usually smaller or with narrower pinnae than sterile fronds, lamina unipinnate; stipes brown to castaneous, glossy, grooved, 30.0–46.0 cm long in sterile fronds and 26.0–83.0 cm in fertile frond, scaly at base; lamina 46.0–53.0 x 36.0–40.0 cm in sterile frond and 30.0–42.0 x 18.0–24.0 cm in fertile frond, elliptic-oblong in outline; basal pinnae 19.5–21.5 x 6.5–8.0 cm in sterile frond and 10.0–15.0 x 3.0–5.5 cm in fertile frond, alternate or subopposite, subsessile to stalked, stalks 0.3–0.5 mm long, asymmetric, broadly lanceolate-oblong, apex acuminate, base oblique, margin entire, basiscopic lobe absent; lateral pinnae 1–2 pairs, 21.0–25.0 x 7.5–8.0 cm in sterile frond and 10.5–14.0 x 2.5–5.0 cm in fertile frond, subopposite, elliptic-oblong, apex acuminate, base acute or fused with costa, margin entire, interval 6.5–8.0 cm in sterile frond and 3.0–4.0 cm in fertile frond; terminal pinna 36.0–45.0 x 25.0–30.0 cm in sterile frond and 14.0–22.0 x 14.0–16.0 cm in fertile frond, ovate in outline, apex acuminate, base cuneate to attenuate, margin entire or trilobed, bearing a large middle lobe and smaller adjacent two lobes, central lobe 29.0–40.0 x 10.0–15.0 cm in sterile frond and 11.0–20.0 x 3.5–11.0 cm in fertile frond, elliptic-oblong, apex acuminate, margin entire, pairs of adjacent lobes 20.0–27.0 x 5.0–8.0 cm in sterile frond and 7.0–12.0 x 2.0–4.0 cm in fertile frond, asymmetric, elliptic-oblong, apex acuminate, margin entire; chartaceous, glabrous on both surfaces except few short hairs on midrib or main veins beneath, venation anastomosing forming many areoles and areolules with included free veinlets, veinlets usually forked, costal areoles more or less having free included veinlets. *Sori* elongate, confluent, sometimes round, dorsal anastomosing veins, arranged in 4–5 irregular rows between main veins; exindusiate. **Fig. 4.34.**

Thailand.— SOUTH-EASTERN: Trat (Ko Khlum); PENINSULAR: Surat Thani (Bandon), Phangnga (Khao Lak-Lumru National Park), Phuket (Khao Kluay, Khao Phara), Krabi (Khao Phanom Bencha National Park), Nakhon Si Thammarat (Chawang, Khao Luang National Park, Khao Nan National Park), Phatthalung (Khao Pu-Khao Ya National Park), Trang (Khao Chong, Ko Libong, Phu Pha Mek), Satun (Thale Ban National Park), Song Khla (Bukit Bessar, Khao Ao Khuan, Ko Hong Hill, Namtok Boriphat Forest Park), Yala (Betong, Kue Long), Narathiwat (Hala-Bala Wildlife Sanctuary, Su-ngai Kolok).

Distribution.— Malesia [Peninsular Malaysia (type), Singapore, Sumatra, Berhala Island, Borneo].

Ecology.— Terrestrial on shady mountain slopes in dense evergreen forest from sea level to 1,000 m alt.

Vernacular.— Ne ra pu si (เนระพูสี) (Peninsular).

Note.— It is noted that some Malesian specimens kept at K bearing wing at stipe and rachis (*W. Griffith* s.n.), but it is not found in Thai specimens. In addition, simple fronds were rarely found in Thai plants.

Specimens examined.— **THAILAND:** Nakhon Si Thammarat, Khao Luang National Park, c 200 m, 8 Nov. 1927, *A.F.G. Kerr* s.n. (BK); Trang, Khao Chong Waterfalls, 8–10 Jan. 1993, *A. Khowanich* 53 (KKU); *ibid.*, *A. Khowanich* 54 (KKU); Songkhla, Rattaphum, Namtok Boriphat Forest Park, 200 m, 17 Jul. 1984, *A. Tongphan* 17 (PSU); Nakhon Si Thammarat, Khao Ao Khuan, 40 m, 18 Sep. 1966, *B. Hansen and T. Smitinand* 11985 (K, L); Trang, Ko Libong, 200 m, 2 Oct. 1966, *B. Hansen and T. Smitinand* 12217 (BKF); Trang, Khao Chong, 1 Oct. 1968, *B. Sangkhachand* 1515 (BKF); Trat, Ko Khlum, 11° 55' N, 102° 21' E, 0–50 m, 19 Nov. 1970, *C. Charoenphol, K. Larsen & E. Warncke* 5043 (BKF), Nakhon Si Thammarat, Lan Saka, Khao Luang National Park, Karome Waterfalls, 8° 22.4' N, 99° 44.2' E, 160 m, 8 Sep. 2008, *D.J. Middleton, P. Triboun, V. Chamchumroon, S. Saengrit & R. Simma* 4380 (E); Phangnga, Takua Pa, Khao Lak National Park, 8° 38' N, 98° 14' E, 20 m, 4 Dec. 2003, *D.J. Middleton, S. Lindsay & R. Pooma* 2166 (BKF); Trang, Yan Ta Khao, Khao Banthat Mountains, trail to summit to Phu Pha Mek, Nam Sai River, c 500 m, 4 Jun. 2003, *D.J. Middleton, V. Chamchamroon, S. Lindsay, R. Pooma & S. Suwanachat* 1903 (BKF); Songkhla, Bukit Besar, 29 Apr. 1899, *D.T. Gwynne-Vaughan* 383 (K); Phuket, Khao Phara, c 150–370 m, 25 Jan. 1966, *E. Hennipman* 3732 (B, BKF, L, U); Nakhon Si Thammarat, Khao Luang National Park, 8° 30' N, 99° 45' E, c 625 m, 3 Feb. 1966, *E. Hennipman* 3801 (L); Nakhon Si Thammarat, Khao Rum, *E. Smith* 541 (K); Surat Thani, Bandon, May 1923, *E. Smith* 2850 (K); Trang, Khao Chong, 100–300 m, 5 Jan. 1979, *H & C* 193 (PSU); Songkhla, Rattaphum, Namtok Boriphat Forest Park, 25–150 m, 21 Dec. 1978, *H & C* 251 (PSU); Songkhla, Hat Yai, Ko Hong Hill, 75 m, 25 Jan. 1986, *J.F. Maxwell* 86-54 (PSU); Phatthalung, Si Banphot, Khao Pu-Khao Ya National Park, near Tham Mat Cha, 50 m, 15 Jun. 1986, *J.F. Maxwell* 86-384 (PSU); Nakhon Si Thammarat, Khao Luang National Park, Krung Ching Waterfalls, 350 m, 12 Aug. 1986, *J.F. Maxwell* 86-580 (CMU, PSU); Nakhon Si Thammarat, Chawang, 100–200 m, 25 Jan. 1958, *K. Larsen & B. Hansen* 673 (E); Narathiwat, Su-ngai Kolok, Nikom Waeng, 5° 50' N, 101° 50' E, 300–400 m, 3 Jan. 1974, *K. Larsen & S.S. Larsen* 32793 (BKF); Satun, Thale Ban National Park, 6° 42' N, 100° 10' E, 100 m, 27 Aug. 1995, *K. Larsen, S.S. Larsen, C. Tange, R. Moran, T. Niyomdham & P. Puudjaa* 46080 (BKF); Nakhon Si Thammarat, Khao Luang National Park, 19 Feb. 1962, *K. Yoda* 647 (BKF); Trang, Khao Chong, c 100 m, 29 Mar. 1965, *M. Tagawa & I. Yamada* T-171 (BKF, L); Nakhon Si Thammarat, Khao Luang National Park, 25 Jul. 2014, *R. Pollawatn* 2114 (BCU); Krabi, Mueang Krabi, Khao Phanom Bencha National Park, Huai Tai Waterfalls, 8° 14' N, 98° 55' E, 5 Sep. 2002, *R. Pooma, V. Chamchumroon, N. Koonkhunthod, P. Chantaboorn* 3634 (BKF); Yala, Betong, Dao Dueng Waterfalls, 800 m, 24 May 1993, *T. Boonkerd* 1196 (BCU, K); Nakhon Si Thammarat, Khao Nan National Park, Huai Lhek, 7 Apr. 2006, *T. Boonkerd, S. Chantanaorrapint & W.*

*Khwaiphan* 51 (BCU); *ibid.*, 11 Oct. 2007, *T. Boonkerd, Y. Sirichamorn & C. Sanguansab* 249 (BCU); Nakhon Si Thammarat, Chawang, c 100 m, 24 Jan. 1958, *T. Smitinand* 4090 (BKF, K); *ibid.*, 100–200 m, 25 Jan. 1958, *T. Sorensen, K. Larsen, B. Hansen* 673 (K); *Winit* s.n. (BKF);

**MALESIA: Peninsular Malaysia**, *A.G. Piggott* 2175, 2754 (K), *A.S.B. Abdullah* 247 (K), *B.S. Parris* 10380 (K), *C.B. Robinson* s.n. (K), *Dr. King's Collector* 5281 (K), *E.S. & G. Hose* 5029, 5046 (K), *J. Sinclair* 39898 (K, L), *K.M. Kochummen* 78959 (K, L), *K.B. Tassim* K.449 (BM), *Maingay* 1809 (K), *P.J. Edwards* 3512 (L), *P.J. Edwards, B.S. Parris* 10380 (K), *R.E. Holttum* 19327, 24692 (BM), *R.E. Holttum* s.n. (K), *R. Jaman & Zainudin* PL49, PL100 (K), *Roxburgh* 2387 (BM), *Roxburgh* 2396 (BR), *S.C. Chin & Mustafa* 3300 (L), *T. Shimizu, K. Iwatsuki, N. Fukuoka, M. Hutoh & B.C. Stone* M-14008 (L), *W. Griffith* s.n. (K, L), *W.S.C. Pinwill* s.n. (K), **Singapore**, *Dr. King's Collector* 342 (K), *F. Kehding* 2960 (BM, P), *R.E. Holttum* 19227, 24507 (K), *W. Norris* s.n. (K), *R.W. Hullett* s.n. (BM), **Sumatra**, *W. Troll* s.n. (BM (photo)), *Franken & Roos* 13 (L), **Berhala Island**, *Lörzing* 17256 (L), **Borneo**, *C. Bernard, M. van Beek, F. Breman* 6122 (L).

**35. *Tectaria siifolia*** (Willd.) Copel., *Philipp. J. Sci.*, C 2: 414. 1907; *Backer & Posth.*, *Varenfl. Java*: 75. 1939; *Copel.*, *Fern Fl. Philipp.*: 314. 1960; *D.L. Jones & S.C. Clemesha*, *Austral. Ferns & Fern Allies* 2: 208, f. 290. 1981; *S.B. Andrews*, *Ferns Queensland*: 46, f. 3.12. 1990; *Holttum*, *Fl. Males.*, Ser. 2, *Pterid.* 2: 84. 1991; *I.M. Turner*, *Gard. Bull. Singapore* 47(1): 55. 1995; *Bostock*, *Fl. Australia* 48: online, f. 133E–F. 1998; *Boonkerd & Pollawatn*, *Pterid. Thailand*: 216. 2000; *Subh. Chandra*, *Taiwania* 45(1): 58. 2000; *Subh. Chandra, Fraser-Jenk., Alka Kumari & Archana Sriastava*, *Taiwania* 53(2): 197. 2008; *S. Linds., D.J. Middleton, Boonkerd & Suddee*, *Thai For. Bull.*, *Bot.* 37: 98. 2009; *Fraser-Jenk.*, *Bull. Natl. Mus. Nat. Sci.*, Ser. B 38(4): 176. 2012; *Wardani & Jaenudin*, *Proc. Int. Conf. Resource Conservation*: 182. 2013. Type: Java, *Ventenat* s.n. [holotype B! (B -W 19689 -01 0)].

*Polypodium siifolium* Willd., *Sp. Pl.* 5: 196. 1810. Type: as for above.

*Aspidium siifolium* (Willd.) Mett., *Ann. Mus. Bot. Lugd.-Bat.* 1: 237. 1864; *Malayan Ferns*: 251. 1908. Type: as for *P. siifolium*.

*Dryomenis phymatodes* Fée, *Mém. Foug.* 5. Gen. Filic: 225, pl. 18A, f. 1. 1852. Type: Philippines, Luzon, *Cuming* 4 [lectotype (designated here) K! (K000360762), isolectotypes BM, K! (K000360760, K000360761), L!, MICH! (photo seen MICH1190387), US! (photo seen US00135266, US01100960, US01100961)].

*Dryomenis menisciocarpon* T. Moore, *Index Filic.* (T. Moore): 47. 1857. Type: as for *D. phymatodes*.

*Aspidium menisciocarpon* (T. Moore) Mett., *Farngatt.* 4: 121. 1858. Type: as for *D. phymatodes*.

*Aspidium teysmannianum* Hook., *Sp. Fil.* 4: 41, t. 236. 1862. Type: Sumatra, Pulu Pisang, *Teijsmann* s.n. [holotype K! (K000237455), isotype K! (K000237456)].

*Aspidium siifolium* (Willd.) Mett. var. *teysmannianum* (Hook.) Christ, *Ann. Jard. Bot. Buitenzorg* 15: 138. 1898. Type: as for *A. teysmannianum*.

*Aspidium biseriatum* Christ, *Bull. Herb. Boissier*, sér. 2, 6: 1002. 1906. Type: Philippines, Luzon, Zambales, *Loher* s.n. (n.v.).

*Aspidium ternifolium* Alderw., Bull. Jard. Bot. Buitenzorg, Ser. 2, 11: 3. 1913; Malayan Ferns Suppl.: 194. 1917. Type: Malaysia, Perak, Gopeng, *Matthew* 510 [holotype BO, isotypes K! (K000236475, K000236476)].

*Tectaria ternifolia* (Alderw.) C. Chr., Index Filic. Suppl. 3: 185. 1934; Holttum, Gard. Bull. Singapore 9: 138. 1937; Rev. Fl. Malaya ed. 1, 2: 516, f. 303. 1955 [‘1954’]; Tagawa & K. Iwats., Fl. Thailand 3(3): 378. 1988; Boonkerd & Pollawatn, Pterid. Thailand: 217. 2000. Type: as for *A. ternifolium*.

*Aspidium papyraceum* Alderw., Bull. Jard. Bot. Buitenzorg, Ser. 3, 2: 131. 1920. Type: Sumatra, Benkoelen, *Brooks* 3771S [holotype BO, isotype BM! (BM001048610)].

*Tectaria papyracea* (Alderw.) C. Chr., Index Filic. Suppl. 3: 183. 1934. Type: as for *A. papyraceum*.

*Rhizome* short, erect or ascending, densely scaly at apex; scales basifixed, bicolored, dark brown centrally with narrow paler margin, 5–10 × 1–1.5 mm, linear-lanceolate, apex acuminate, margin subentire. *Fronde*s dimorphic, trifoliate to quinquefoliate. *Sterile fronds*, stipes stramineous to pale castaneous, glossy, grooved, 16.0–26.0 cm long, covered with short hairs throughout, scaly at base; lamina ovate-subdeltoid, 10.0–25.0 × 11.5–20.0 cm; basal pinnae 10.0–15.0 × 4.0–6.0 cm, stalked, stalk 0.2–0.5 cm long, opposite, asymmetric, ovate-elliptic, apex acuminate to caudate, base acute, margin entire or irregular lobed, basiscopic lobe absent; lateral pinnae 1 pair or none, sessile, 13.5–15.0 × 5.0–6.5 cm, opposite, ovate-elliptic, apex acuminate to caudate, base acute, margin entire or broadly crenate; terminal pinna simple or trilobed, 14.0–18.0 × 6.0–17.0 cm, elliptic-ovate, apex acuminate to caudate, base round to cuneate, margin entire or lobed, bearing central lobe the largest and a pair of lateral lobes, central lobe 12.0 × 6.0 cm, ovate-elliptic, apex acuminate, margin entire, lateral lobes 9.0 × 3.5 cm, lanceolate, apex acuminate, margin entire; chartaceous, glabrous on both surface except few short hairs on sinus, midrib and main veins, venation fully anastomosing forming irregular areoles with free included veinlets, veinlets free, usually forked, costal areoles having branched included veinlets; *Fertile fronds*, stramineous to dark brown, glossy, grooved, 30.0–40.0 cm long, covered with short hairs throughout, scaly at base; lamina ovate, 6.0–10.0 × 3.0–8.0 cm; basal pinnae 3.5–5.5 × 2.0–2.5 cm, ovate, apex acuminate, base acute to slightly cuneate, margin entire to slightly crenate, basiscopic lobe absent; lateral pinnae 1 pair or none, subsessile, 4.0–4.5 × 1.5–2.5 cm, elliptic, apex acuminate, base acute, margin entire; terminal pinna 6.0 × 2.5 cm, elliptic, apex acuminate, base cuneate, margin entire; chartaceous, glabrous on both surface except few short hairs in sinus, midrib and main veins, venation fully anastomosing forming irregular areoles without free included veinlets, costal areoles lacking free included veinlets. *Sori* round, dorsal on anastomosing veins, usually on cross veins arranged in two rows between main veins; indusia round-reniform, thin, brown, peltate, persistent. **Fig. 4.35.**

Thailand.— PENINSULAR: Nakhon Si Thammarat (Khao Nan National Park); Trang (Khao Phap Pha), Satun, Songkhla (Ton Nga Chang Wildlife Sanctuary).

Distribution.— India (Andaman Islands, Nicobar Islands), Malesia [Peninsular Malaysia, Sumatra, Java (type), Lombok, Timor Leste, Philippines (Luzon)], Australia (NE Queensland).



Ecology.— Terrestrial on mountain slope along a dry stream in evergreen forest, from near sea level to 150 m alt.

Note.— Similar to *Tectaria polymorpha* (Wall. ex Hook.) Copel. in appearance but differing in its dimorphic fronds and a number of pinnae. It is noted here that basal basiscopic lobes of basal pinnae are rarely found.

Specimens examined.— **THAILAND:** Songkhla, Hat Yai, Ton Nga Chang Wildlife Sanctuary, 150 m, 4 May 1986, *J.F. Maxwell* 86-283 (PSU); Satun, near sea level, 11 Jan. 1924, *Put for Eryl Smith* 2689 (K); Nakhon Si Thammarat, Khao Nan National Park, Tham Luang, 26 Jan. 2007, *T. Boonkerd*, *S. Chantanaorrapint*, *W. Khwaiphan* 412 (BCU);

**MALESIA: Peninsular Malaysia**, *B.S. Parris*, *J. Dransfield* 10473 (K), *B.S. Parris*, *P.J. Edwards* 10365 (K), *C.G. Matthew* s.n. (K), *R.E. Holtum* 24693 (K); **Sumatra**, *A. Paterson* 150 (K), *Brooks* 3771S (BM), *C.G. Matthew* s.n. (K), *J.V. Borssum W.* 1766 (K, L), *K. Iwatsuki*, *G. Murata*, *J. Dransfield* & *D. Saerudin* S-1699 (K, L), *Teijsmann* s.n. (K); **Timor Leste**, *I.D. Cowie* & *F. Santana* 10912 (L); **Sulawesi**, *E. Hennipman* 5737 (K, L); **Philippines, Luzon**, *C.G. Matthew* s.n. (K), *Cuming* 4 (BM, K, L, MICH, US), *Cuming* 5 (L), *G.S. Jenman* s.n. (K), *M.G. Price* 1170, 1315, 1547 (K).

**36. *Tectaria simonsii*** (Baker) Ching, *Sinensia* 2(2): 32, pl. 13. 1931; Tardieu & C. Chr., *Fl. Indo-Chine* 7(2): 421. 1941; Ching, *Acta Phytotax. Sin.* 8: 151. 1959; Tagawa & K. Iwats., *S. E. Asian Stud.* 5: 98. 1967; K. Iwats., *Acta Phytotax. Geobot.* 25(2–3): 71. 1972; C.M. Kuo, *Taiwania* 30. 29. 1985; Tagawa & K. Iwats., *Fl. Thailand* 3(3): 374, f. 35.1–3. 1988; Holtum, *Fl. Males.*, Ser. 2, *Pterid.* 2: 67. 1991; I.M. Turner, *Gard. Bull. Singapore* 47(1): 55. 1995; Boonkerd & Pollawatn, *Pterid. Thailand*: 217. 2000; S.G. Lu & T.Y.A. Yang, *Taiwania* 50(2): 158. 2005; Subh. Chandra, Fraser-Jenk., Alka Kumari & Archana Sriastava, *Taiwania* 53(2). 197. 2008; S. Linds., D.J. Middleton, Boonkerd & Suddee, *Thai For. Bull.*, Bot. 37: 98. 2009; Fraser-Jenk., *Bull. Natl. Mus. Nat. Sci.*, Ser. B 38(4). 177. 2012; F.W. Xing, Y.H. Yan, S.Y. Dong, F.G. Wang, Christenh. & Hovenkamp, *Fl. China* 2–3: 743. 2013. Type: India, Assam, Nuka & Naga Hills, *Simons* 301 [holotype K! (K001080670)].

*Nephrodium simonsii* Baker, *Syn. Filic.*: 504. 1874. Type: as for above.

*Aspidium simonsii* (Baker) Bedd., *Suppl. Ferns Brit. Ind.*:15, t. 367. 1876; *Handb. Ferns Brit. India*: 218. 1892. Type: as for *N. simonsii*.

*Aspidium kwarengoense* Hayata, *Icon. Pl. Formosan.* 8: 138. 1919; *Dryomenis kwarengoensis* (Hayata) Nakai, *Bot. Mag. (Tokyo)* 47(555): 160. 1933. Type: China, Taiwan, *Faurie* s.n. (TI, photos B!, K!).

*Tectaria kwarengoensis* (Hayata) C. Chr., *Index Filic.*, *Suppl. Tert.*: 181. 1934; C.E. DeVol & C.M. Kuo, *Fl. Taiwan* 1: 344. 1975; J.L. Tsai & W.C. Shieh, *Fl. Taiwan*, ed. 2: 299. 1994. Type: as for *A. kwarengoense*.

*Sagenia longicruris* Christ, *Bull. Acad. Int. Géogr. Bot.* 16(205–206): 250. 1906. Type: China, Guizhou, *Cavalerie* 268 [lectotype (designated here) P! (photo seen P01440053), isolectotype P! (photo seen P01440052)].

*Aspidium longicrurum* (Christ) Christ, *Bull. Acad. Int. Géogr. Bot.* 20(1): 169. 1909; Hu & Ching, *Icon. Filic.* 1: 14, t. 7. 1930. Type: as for *S. longicruris*.

*Tectaria longicruris* (Christ) C.Chr., Contr. U.S. Natl. Herb. 26: 231. 1931. Type: as for *S. longicruris*.

*Aspidium pachinense* Hayata, Icon. Pl. Formosan. 8: 140–141, f. 65–66. 1919. Type: China, Taiwan, Pachina, *T. Soma* s.n. (holotype TI, photo B!).

*Aspidium subtriphyllum* (Hook. & Arn.) Hook. var. *ebenosum* Nakai, Bot. Mag. (Tokyo) 47(555): 157. 1933. Type: Japan, Ryukyu Islands, Insula Ishigakijima Island, *S. kanagusuku* s.n. (*n.v.*).

*Tectaria subtriphylla* (Hook. & Arn.) Copel. var. *ebenosa* (Nakai) Nemoto, Fl. Japan (ed. 2): 76. 1936. J.L. Tsai & W.C. Shieh, Fl. Taiwan, ed. 2: 301. 1994. Type: as for *A. subtriphyllum* var. *ebenosum*.

*Rhizome* short, erect to ascending, bearing a tuft of fronds at apex, densely scaly at apex; scales basifixed, concolorous, deep castaneous to dark brown, 4–8 × 1–2 mm, lanceolate, apex acuminate, margin entire. *Fronde*s monomorphic, lamina simple when young, becoming bipinnatifid to bipinnate at base and unipinnate to bipinnate upwards when mature; stipes mostly purplish to nearly black, sometimes dark brown, polished, grooved abaxially, 18.0–80.0 cm long, covered with a few short hairs throughout, scaly at base; lamina ovate-subdeltoid, 24.0–55.0 × 22.0–35.0 cm, basal pinnae 16.0–26.0 × 8.0–18.0 cm, opposite or subopposite, asymmetric, stipitate, stalk 1.5–4.0 cm long, ovate in outline; basal pinnule 12.0–15.0 × 3.0–3.5 cm, stipitate, 0.1–1.0 cm long, elliptic-lanceolate, apex acuminate, base round to asymmetrically cuneate, margin subentire to shallowly crenate, more or less bearing elongate basal basispic lobes, 8.0–11.0 × 2.5–3.0 cm, lanceolate, apex acuminate, margin subentire to shallowly crenate; apical pinnule 2.5–8.0 × 1.5–4.0 cm, stipitate, 0.1–1.0 cm long, lanceolate, apex acute to acuminate, base round to subtruncate, margin entire to slightly crenate, often bearing short acroscopic lobes, 1.0–2.0 × 0.5–1.0 cm, lanceolate, apex acuminate, margin entire; terminal pinnule 12.0–22.0 × 5.0–9.0 cm, elliptic or ovate-subtriangular, apex acuminate, base asymmetrically cuneate, margin subentire or bearing basispic lobe or trilobed with one central lobe and a pair of lateral lobes, central lobe 17.0–20.0 × 3.0–5.0 cm, lanceolate, apex acuminate, margin subentire to shallowly crenate, basispic lobes or pairs of lateral lobes 7.0–12.0 × 2.0–4.0 cm, lanceolate-elliptic, apex acuminate, margin entire to slightly crenate; lateral pinnae 1–3 pairs or none, 13.0–21.0 × 2.5–16.0 cm, opposite or subopposite, stipitate, stalk 0.5–1.5 cm long, lanceolate or lanceolate-oblong, apex acuminate, base asymmetrically cuneate, margin subentire to shallowly lobed, interval 8.0–13.0 cm, basal acroscopic lobes and basal basispic lobes often present, lanceolate, apex acuminate, margin subentire; pinnules sometimes present if lateral pinnae pinnate, basal pinnules 8.0–10.0 × 2.0–3.0 cm, shortly stalked, lanceolate, apex acuminate, base subtruncate to asymmetrically cuneate, margin subentire to shallowly crenate; apical pinnules 2.0–3.0 × 1.0–1.5 cm, shortly stalked, ovate, apex acute, base round, margin entire; terminal pinnules 12.0–16.0 × 3.5–4.0 cm, oblong-lanceolate, apex acuminate, base acute, margin subentire to shallowly crenate; terminal pinna 14.0–24.0 × 8.0–26.0 cm, ovate-lanceolate, apex acuminate, base acute to cuneate, margin trilobed, central lobe 10.0–21.0 × 3.5–8.0 cm, lanceolate-elliptic, apex acuminate, margin subentire, pairs of lateral lobes 8.0–15.0 × 2.5–5.0 cm, lanceolate-elliptic, apex acuminate, margin subentire to shallowly lobed; chartaceous, glabrous on both surface except few short hairs on sinus, midrib and main veins, veins fully anastomosing forming irregular areoles with free included veinlets, veinlets free,

simple or forked, costal areoles having free branched included veinlets. *Sori* round, dorsal usually on junction of anastomosing veins or on coupling veinlets; exindusiate. **Fig. 4.36.**

Thailand.— NORTHERN: Chiang Rai [Lam Nam Kok National Park, Mae Lao, Phan (Mae Kao Luang Community Forest)], Lampang, Phitsanulok (Thung Salaeng Luang National Park); NORTH-EASTERN: Phetchabun (Khao Ko), Loei (Nong Hin, Phu Hin Rong Kla National Park, Phu Kradueng National Park); EASTERN: Chaiyaphum (Phu Khiao Wildlife Sanctuary); SOUTH-EASTERN: Chonburi (Si Racha); SOUTH-WESTERN: Uthai Thani (Ban Rai); PENINSULAR: Chumphon (Bang Son).

Distribution.— India [Sikkim, Assam (type)], China (Yunnan, Guizhou, Guangxi, Hainan, Guangdong, Fujian, Taiwan), Japan (Ryukyu Islands), Laos, Vietnam, Malesia (Peninsular Malaysia, Java, Borneo).

Ecology.— Terrestrial in shady area on mountain slopes in dense evergreen forest at 300–1,250 m alt.

Specimens examined.— **THAILAND:** Chaiyaphum, Phu Khiao Wildlife Sanctuary, *A. Sathapattayanon* 697 (BCU); Loei, Phu Kradueng National Park, Phen Phop Waterfalls, 1,160 m, 9 Sep. 1988, *H. Takahashi & MN. Tamura* T-63445 (BKF); Chiang Rai, Lam Nam Kok National Park, 400 m, 23 Sep. 1967, *K. Iwatsuki, N. Fukuoka, M. Hutoh & D. Chaiglom* T-10889 (BKF); Phitsanulok, Thung Salaeng Luang National Park, c 300–600 m, 12 Dec. 1965, *M. Tagawa & N. Fukuoka* T-2102 (BKF); Phetchabun, Khao Kho, Kaeng Ratchapruak, *Nachol* T. 11 (BCU); *ibid.*, *Nachol* T. 22 (BCU); *ibid.*, *Nachol* T. 48 (BCU); *ibid.*, *Nachol* T. 75 (BCU); *ibid.*, *Nachol* T. 76 (BCU); *ibid.*, *Nachol* T. 77 (BCU); *ibid.*, *Nachol* T. 78 (BCU); Loei, Phu Kradueng National Park, trail from Phen Phop Waterfalls to Khun Pong Waterfalls, c 1,200 m, *P. Jadprajong* 190 (BCU); Loei, Dan Sai, Phu Hin Rong Kla National Park, Man Daeng Waterfalls, 9 Jul. 2014, *Sirisak* W. 009 (BCU); Loei, Nong Hin, Suan Hom Waterfalls, 422 m, 19 Jan. 2011, *T. Boonkerd et al.* 2011-5 (BCU); Loei, Nong Hin, 18 Mar. 2011, *T. Boonkerd et al.* 2011-86 (BCU); *ibid.*, 550 m, 26 May 2011, *T. Boonkerd et al.* 2011-207 (BCU); *ibid.*, 750 m, 7 Jul. 2012, *T. Boonkerd et al.* 2011-627 (BCU); *ibid.*, 440 m, 18 Oct. 2012, *T. Boonkerd et al.* 2011-700 (BCU); Chiang Rai, Mae Lao, 610 m, 24 Sep. 1922, *Winit* 967 (BKF); Loei, Dan Sai, Phu Hin Rong Kla National Park, Man Daeng Waterfalls, *W. Rattanathirakul* 102 (BCU); *ibid.*, *W. Rattanathirakul* 131 (BCU); *ibid.*, *W. Rattanathirakul* 194 (BCU);

**INDIA:** Sikkim, *Beddome* s.n. (K), *Dodgson* s.n. (K); Assam, *Gamble* s.n. (K), *Godwin Austen* s.n. (P), *Griffith* 830 (B), *G. Mann* s.n. (BM, K, L), *Griffith* s.n. (K), *Simons* 301 (K), *Wallich* s.n. (K); **LAOS:** *Eberhardt* 1226 (BM, P), *Eberhardt* 5096 (K, P), *Eberhardt* 5122 (P), *J.E. Vidal* 2151, 2611a (P), *Poilane* 2408 (K); **VIETNAM:** *Colani* 2718 (BM, P), *H. van der Werff*, *B. Gray & N.K. Dao* 14197 (P), *H. van der Werff*, *N.K. Dao*, *B. Gray & D.T. Doan* 17487 (PE), *R.P. Bon* 4872 (BM), *Schmid* s.n. (P); **CHINA:** Yunnan, *A. Henry* 13469 (K), *J. Cavalerie* 1914, 2879, 7028, 7294, 7730 (K), *K.M. Feng* 12355, 13853 (PE); Guizhou, *Cavalerie* 1 (P), *Cavalerie* 102 (BM, P), *Cavalerie* 268 (P), *Cavalerie* 1918 [BM (line drawing)], *Cavalerie* 3889 (K), *J. Esquirol* 4055 (K); Guangxi, *A. Henry* 49bis (K), *C.W. Chen* Wade2498 (TAIF), *Morse* 74 (K), *H.N. Qin et al.* 891418 (K), *S.S. Sin and K.K. Whang* 107 (B); Hainan, *E.D. Merrill* 16174 (BM), *E. Smith* 1601 (BM), *G.M. Zhang et D. Li* 061, 066 (PE), *Tsang & Fung* 656 (K), *Tsang & Fung* 17857 (PE),

Wuzhishan Fern Survey 179 (PE); **Guangdong**, *J. Cavalerie* 102 (P), *W.T. Tsang* 675 (BM); **Taiwan**, *Beijing Youth Team* 1003 (TAIF), *B.J. Wang* 4076, 4231, 11746, 11777, 15034, 16100 (TAIF), *C.C. Chen* 3153 (TAI), *C.E. DeVol* 8047 (TAI), *C.K. Liou* 1282 (TAI), *C.M. Kuo* 914, 1596, 1596A, 1893, 1940, 2006, 7421, 7709, 13814 (TAI), *C.S. Kuoh* 4023, 4167 (TAI), *C.Y. Lin*, *P.Y. Chen* 161 (TAI), *Do* 761, 772 (TAI), *Faurie* 150 (B), *Faurie* s.n. [B (photo), K (photo)], *G. Masamune*, *S. Suzuki* s.n. (TAI), *H. Ohashi*, *Y. Tateishi*, *J. Murata*, *Y. Endo*, *T. Nemoto* & *Y. Ueno* 14755 (TAI), *H.Y. Chen* 1267 (TAIF), *I. Simozawa* 178, 184, 762 (TAI), *J.L. Gressitt* 263 (B, BM, K, L), *J.Y. Hwang* & *C.Y. Hwang* 28 (TAI), *K. Odashima* 17749 (B, BM, L, TAI), *K. Mori* s.n. (TAI), *Kuo et Yu* 14840, 14868 (TAI), *K.C. Yang*, *Y.H. Chen* s.n. (TAIF), *M.L. Weng* 1044, 1222, 1318 (TAI), *M.J. Jung* 0074 (TAIF), *M. Tagawa* 910 (BM), *M. Tagawa* 926 (K), *M. Tagawa* 1374 (P), *M. Tagawa* 1951 (BM), *M. Tagawa* 2764 (P), *M. Tagawa* 2844 (BM), *P.H. Lee* 1353 (TAIF), *P.F. Lu* 1524, 1735, 1788, 2619, 2623, 3196, 4138, 4168, 4947, 6029, 7745, 7781, 8287, 9555, 10622, 12227, 13378, 15064, 15268, 17028, 19487, 19593, 21028, 21375, 21418, 26463, 26736, 27113, 27362, 27585, 27664, 27966, 28036, s.n. (TAIF), *R. Sho* 107 (TAI), *S. Suzuki* 6394, 10613, s.n. (TAI), *T. Tanaka* 16 (BM), *T. Tanaka* 17749 (TAI), *U. Faurie* 44 (L), *W.H. Wu* Wu944 (TAIF), *W. Hancock* 153 (PE), *Y.H. Chang* 20070317-001, 20080622-007, 20080622-008, 20081104-002, 20081125-024, 20081125-025, 20081128-013, 20130727-012, 20130727-014, 20141025-004 (TAIF), *Yih-Hann Chang* 978 (TAI), *Y. Shimada* 17749 (PE), *Y. Yamamoto* s.n. (TAI); **JAPAN: Ryukyu Islands**, *E.H. Walker*, *S. Sonohara*, *S. Tawada*, *T. Amano* 6120 (K), *G. Koidzumi* s.n. (BM, L, P), *K. Suzuki* 249247 (L), *S. Kurata* & *T. Nakaike* 2888 (K, L); **MALESIA: Peninsular Malaysia**, *A.G. Piggott* 2981, 3074 (K), *B. Molesworth Allen* 4947 (K); **Java**, *Mousset* 47 (B), *Mousset* 617 (BKF), *Mousset* 11233a (P); **Borneo**, *H.F. Comber* 4197 (K).

**37. *Tectaria singaporiana*** (Wall. ex Hook. & Grev.) Copel., *Sarawak Mus. J.* 2: 368. 1917; *Holttum*, *Rev. Fl. Malaya* ed. 1, 2: 512. 1955 [‘1954’], as ‘*singaporeana*’; *Tagawa* & *K. Iwats.*, *S. E. Asian Stud.* 5: 98. 1967, as ‘*singaporeana*’; *K. Iwats.*, *Amer. Fern J.* 63(3): 131, 133. 1973, as ‘*singaporeana*’; *Tagawa* & *K. Iwats.*, *Fl. Thailand* 3(3): 380. 1988, as ‘*singaporeana*’; *Holttum*, *Fl. Males.*, Ser. 2, *Pterid.* 2: 100. 1991, as ‘*singaporeana*’; *I.M. Turner*, *Gard. Bull. Singapore* 47(1): 55. 1995, as ‘*singaporeana*’; *Bidin* & *Jaman*, *ASEAN Rev. Biodivers. Environm. Conservation*: 8. 1999, as ‘*singaporeana*’; *Boonkerd* & *Pollawatn*, *Pterid. Thailand*: 217. 2000, as ‘*singaporeana*’; *S. Linds.*, *D.J. Middleton*, *Boonkerd* & *Suddee*, *Thai For. Bull., Bot.* 37: 98. 2009, as ‘*singaporeana*’. Type: Singapore, *Wallich* 374 [lectotype E! (photo seen E00416070); isolectotypes BM! (BM001048650), BR! (photo seen BR0000013247553), E! (photo seen E00416071, E00748929), K! (K000236541, K000236542), P! (photo seen P00398251)].

*Aspidium singaporianum* Wall. ex Hook. & Grev., *Icon. Fil.*: t. 26. 1827; *Hook.*, *Sp. Fil.* 4: 43. 1862; *Bedd.*, *Ferns Brit. India* 1: 168, t. 168. 1870; *Handb. Ferns Brit. India*: 212, f. 107. 1883; *Alderw.*, *Malayan Ferns*: 235. 1908; *Bonap.*, *Notes Pterid.* 14: 50. 1923. Type: as for above.

*Podopeltis singaporiana* (Wall. ex Hook. & Grev.) Fée, Mem. Foug. 5: 286. 1852 [1850]. Type: as for *A. singaporiana*.

*Nephrodium singaporianum* (Wall. ex Hook. & Grev.) Baker, Syn. Fil. (ed. 2): 296. 1874. Type: as for *A. singaporiana*.

*Tectaria singaporiana* (Wall. ex Hook. & Grev.) Ching, Sinensia 2(2): 25. 1931, *nom. illeg. hom.* Type: as for *A. singaporiana*.

*Polypodium phyllitidis* Roxb., Calcutta J. Nat. Hist. 4: 483. 1844, *nom. illeg. hom.* Type: *s.l.*, Roxburgh s.n. [holotype BR! (photo seen BR0000006985011)].

*Rhizome* short, erect, bearing a tuft of fronds at apex, scaly; *scales* gradually narrowing from base towards apex, concolorous, dark brown, 4–6 × 1–2 mm, lanceolate, apex acuminate, margin hairy, hairs filamentous, short. *Fronds* monomorphic or sometimes slightly dimorphic, stipes castaneous, glossy, grooved abaxially, 7.0–23.0 cm long in sterile fronds and 9.0–44.0 cm long in fertile fronds, glabrescent; lamina simple, 23.0–32.0 × 6.0–9.5 cm in sterile fronds and 22.0–41.0 × 4.0–9.0 cm in fertile fronds, broadly lanceolate-elliptic, apex acuminate, base cuneate to attenuate, sometimes acute, margin entire, glabrous on both surface except few short hairs on midrib and main veins beneath, chartaceous, venation copiously reticulate forming main areoles and smaller areoles bearing branched included free veinlets, costal areoles bearing branched included veinlets. *Sori* small, round, usually dorsal on anastomosing veins, arranged in two rows between adjacent cross veins and 4–5 rows between main veins; indusia round-reniform, peltate, caducous. **Fig. 4.37.**

Thailand.— PENINSULAR: Surat Thani (Bandon, Khlong Phanom National Park), Krabi (Koh Lanta), Nakhon Si Thammarat (Chawang, Khao Luang National Park, Khiriwong, Khao Nan National Park, Ron Phibun, Thung Song), Phatthalung (Tamot), Trang (Khao Chong, Phu Pha Mek), Satun (Khuan Don), Songkhla (Khao Nam Khang National Park, Ko Hong Hill, Namtok Boriphat Forestry Park), Yala (Bannang Sata, Bang Lang National Park, Hala-Bala Wildlife Sanctuary, Than To), Narathiwat (Si Sakhon, Sukhirin, Waeng).

Distribution.— Malesia [Peninsular Malaysia, Singapore (type), Sumatra, Borneo, Moluccas].

Ecology.— Terrestrial in shaded area on mountain slopes near stream in evergreen forest at 100–950 m alt.

Vernacular.— Tan loi (ตานลอย) (Peninsular).

Note.— According to Copeland (1917), the specific epithet is ‘*singaporiana*’. It should be noted here that the specific epithet ‘*singaporeana*’ is incorrect in some publications, i.e. Boonkerd and Pollawatn (2000); Holttum (1954, 1991b); Lindsay et al. (2009); Tagawa and Iwatsuki (1967, 1988); Turner (1995), etc. In addition, monomorphic frond with abnormally irregular lobed margin or bilobed apex are rarely observed.

Specimens examined.— **THAILAND:** Satun, Khuan Don, c 400 m, 11 Mar. 1928, *A.F.G. Kerr* 14493 (BK, K); Surat Thani, Khlong Phanom National Park, c 100 m, 28 Feb. 1930, *A.F.G. Kerr* 18311 (BK, K); Krabi, Ko Lanta, c 300 m, 15 Apr. 1930, *A.F.G. Kerr* 18982 (BM, K); Narathiwat, Waeng, 24 Aug. 1966, *B. Sangkhachard & B. Nimanong* 1266 (BKF); *ibid.*, 450 m, 21 Sep. 1965, *C. Phengklai & T. Smitinand* 1190 (BKF, L); Nakhon Si Thammarat, Khao Luang National Park, 300–700 m, 19 Feb. 1962, *C. Apasutaya* 177 (BCU); Songkhla, Sadao, Khao Nam Khang National Park, 6° 35′ 52″ N 100° 35′ 18″ E, 90 m, 21 Sep. 2010, *D.J.*

Middleton, K. Bunpha, P. Karaket, S. Lindsay, T. Phutthai, S. Suddee & N. Tetsana 5494 (BKF, P, PSU, QBG); Yala, Than To, Ban Chulaphon Phatthana 7, 6° 5' N 101° 23' E, 120 m, 2 Sep. 2004, D.J. Middleton, M. Phuphat, R. Pooma & K. Williams 2820 (BKF, E); Trang, Yan Ta Khao, Khao Banthat Mountains, trail to summit of Phu Pha Mek, 7° 26' N 99° 50' E, c 300 m, 4 May 2003, D.J. Middleton, V. Chamchumroon, S. Lindsay, R. Pooma & S. Suwanachat 1876 (BKF); *ibid.*, 500 m, 4 Jun. 2003, D.J. Middleton, V. Chamchumroon, S. Lindsay, R. Pooma & S. Suwanachat 1905 (BKF); Nakhon Si Thammarat, Khao Luang National Park, 8° 30' N 99° 45' E, c 625 m, 3 Feb. 1966, E. Hennipman 3816 (BKF, BM, L); *ibid.*, 500–800 m, 7 Feb. 1966, E. Hennipman 3904 (BKF, L); Nakhon Si Thammarat, Ron Phibun, 480 m, Feb. 1922, E. Smith 387 (K); *ibid.*, E. Smith 422 (K); *ibid.*, Khao Rum, Mar. 1922, E. Smith 652 (K); Yala, Banang Sata, 70 m, 28 Jul. 1923, E. Smith 1834 (BKF, K); Yala, Betong, 440 m, 31 Jul. 1923, E. Smith 1835 (K); Surat Thani, Bandon, near sea level, Jun. 1924, E. Smith 2700 (K); *ibid.*, E. Smith 2709 (BM, K); Trang, Khao Chong, 150 m, 16 Aug. 1975, J.F. Maxwell 75-894 (BK, L); Songkhla, Rattaphum, Namtok Boriphat Forest Park, 200 m, 16 Oct. 1984, J.F. Maxwell 84-333 (BKF, PSU); Songkhla, Hat Yai, Ko Hong Hill, 200 m, 1 Jan. 1985, J.F. Maxwell 85-9 (BKF, PSU); Phatthalung, Ta Mot, 200 m, 5 Oct. 1986, J.F. Maxwell 86-746 (BKF, CMU, L, PSU); Nakhon Si Thammarat, Khao Luang National Park, 650–950 m, 24 Aug. 1967, K. Iwatsuki, H. Koyama, M. Hutoh & A. Chintayungkun T-8439 (BKF); *ibid.*, K. Iwatsuki, H. Koyama, M. Hutoh & A. Chintayungkun T-14635 (BKF, L); Phatthalung, Ta Mot, 150 m, 20 Aug. 1995, K. Larsen, S.S. Larsen, C. Tange, R. Moran, T. Niyomdham & P. Puudjaa 45805 (BKF, L, QBG); Song Khla, Khao Nam Khang National Park, 6° 35' N 100° 34' E, 180 m, 28 Aug. 1995, K. Larsen, S.S. Larsen, C. Tange, R. Moran, T. Niyomdham & P. Puudjaa 46107 (BKF, L); Yala, Bang Lang National Park, 200–250 m, 17 Jun. 1992, K. Larsen, S.S. Larsen, S.S. Renner, C. Niyomdham, W. Ueachirakan & P. Sirirugsa 42960 (BKF); Songkhla, Khao Nam Khang National Park, 10 Apr. 1989, K. Makgomol 55 (KKU); Trang, Khao Chong Waterfalls, 8–10 Jan. 1993, K. Makgomol 58 (KKU); Songkhla, Khao Nam Khang National Park, 19 Apr. 1989, K. Makgomol 59 (KKU); *ibid.*, 19 Jun. 1989, K. Makgomol 60 (KKU); *ibid.*, 25 Dec. 1989, K. Makgomol 61 (KKU); Nakhon Si Thammarat, Khao Luang Natinal Park, Krung Ching Waterfalls, 250 m, 2 Dec. 2005, K. Williams, R. Pooma, M. Poopath, V. Chumchamroon 1448 (BKF); *ibid.*, 700–1,000 m, 18 Feb. 1962, K. Yoda 530 (BKF); *ibid.*, 19 Feb. 1962, K. Yoda 619 (BKF); *ibid.*, 680–950 m, 18 Jan. 1966, M. Tagawa, K. Iwatsuki & N. Fukuoka T-4630 (BKF, K, L); Nakhon Si Thammarat, Khao Nan National Park, Sunantha Waterfalls, 100 m, 11 Mar. 2006, O. Ratana 21 (BCU); Nakhon Si Thammarat, Khanom, 1 Jul 2011, P. Nopsiriwong 210 (BCU); Narathiwat, Sukhirin, Khao Nakharat, 8 Aug. 1996, P. Puudjaa 250 (BKF); Narathiwat, Si Sakhon, 26 Apr. 2001, P. Puudjaa 887 (BKF); Yala, Hala-Bala Wildlife Sanctuary, 250 m, 6 Mar. 2000, P. Suksathan 2408 (QBG); Nakhon Si Thammarat, Khao Luang National Park, 25 Jul. 2014, R. Pollawatn 2116 (BCU); Phatthalung, Kong Ra, Khlong Chaloe, Manora Waterfalls, c 300 m, 19 Sep. 2007, S. Chantanaorrapint & A. Chantanaorrapint 35 (PSU); Phatthalung, Ta Mot, Lan Mom Chui Waterfalls, 22 Feb. 1992, S. Indhamusik 4 (PSU); Nakhon Si Thammarat, Chawang, Khao Son, 7 Aug. 1966, Snan 79 (BKF); *ibid.*, 28 Jul. 1956, Snan 764 (BKF); Songkhla, Rattaphum, Namtok Boriphat Forest Park, 30 m, Sep. 1978, T. Boonkerd s.n. (BCU); Narathiwat, 150 m, 20 May 2002, T.

*Boonkerd & R. Pollawatn* 248 (BCU); *T. Boonkerd & R. Pollawatn* 1407 (BCU); Nakhon Si Thammarat, Khao Nan National Park, 13 Mar. 2006, *T. Boonkerd, S. Chantanaorrapint & W. Khwaiphon* 34 (BKF); *ibid.*, 8 Apr. 2006, *T. Boonkerd, S. Chantanaorrapint & W. Khwaiphon* 117 (BKF); *ibid.*, 9 Apr. 2006, *T. Boonkerd, S. Chantanaorrapint & W. Khwaiphon* 132 (BKF); *ibid.*, 1 Oct. 2006, *T. Boonkerd, S. Chantanaorrapint & W. Khwaiphon* 329 (BKF); Nakhon Si Thammarat, Thung Song, 28 Aug. 1967, *T. Shimizu & A. Nalampoorn* T-8225 (BKF, L); Nakhon Si Thammarat, Khao Luang National Park, c 600 m, 7 Aug. 1951, *T. Smitinand* 921 (BKF, K); Nakhon Si Thammarat, Khiriwong, *T. Smitinand* 945 (BKF, P); Nakhon Si Thammarat, Khao Luang National Park, c 600 m, 23 Oct. 1951, *T. Smitinand* 989 (BKF, K); Trang, 100 m, 30 Aug. 1955, *T. Smitinand* 3030 (BKF); Nakhon Si Thammarat, c 600 m, 23 Oct. 1951, *T. Smitinand* 5813 (L);

**MALESIA: Peninsular Malaysia**, *A.G. Piggott* 1512, 2761, 2762, 2865 (K), *A.S.B. Abdullah* 203 (K), *B. Scortechini* 433, s.n. (K), *B.S. Parris, P.J. Edwards* 10400 (K), *Bink* 1804 (BM), *Birch* s.n. (BM), *C.B. Kloss* 35 (K), *C. Christensen* 1217 (BM), *C.W. Chen Wade* 4371 (TAIF), *Cuming* 201, 402 (E), *Cuming* 403 (BM, E, L), *D. Hou* 621 (BM), *D.T. Gwynne-Vaughan* 352 (K), *D.W. Lee* UL-9 (K), *E.A. Turnau* 820 (K), *E.J.C.* s.n. (K), *E.S.G. Hose* 162, 5036 (K), *F. Henderson* 44/201 (E), *F.S.P. Ng* FRI 1663 (L), *G. King* s.n. (P), *Gaudichard* 20, 70 (P), *H.N. Ridley* 12514, 14450, s.n. (K), *Hance* 164 (K), *Hassan & Kadim* H.4 (BM, L), *Henderson* s.n. (E), *J.W. Purseglove* P.5580 (BM), *Kadim & Noor* K.622 (BM, L), *Kiah* s.n. (BM), *K. Imin* FRI 68033 (L), *K. Iwatsuki, N. Fukuoka & M. Hutoh* M-14206 (L), *K. N. Kaimal* s.n. (E), *K. Ogata* 10022, 10170, 10174 (L), *L.W. Norus* 3351 (BM), *L. Wray* 757 (K, P), *M. Nur* 11524 (K), *M. Shah* 193 (BM), *N. Cantley* 4338 (K), *Neple* 201 (BM), *P.J. Edwards, B.S. Parris* 10559 (K, L), *R.D. Worthington* 13447 (L), *R.E. Holttum* 9760 (K), *Ridley* 4338 (B), *R. Melville* 4731b (K), *R.W. Hullett* 609 (BM), *S.W. Norris* s.n. (K), *Seemann* 2301 (K), *Teysmann*. 16637 (P), *T. Shimizu, K. Iwatsuki, N. Fukuoka, M. Hutoh & B.C. Stone* M-14007 (BKF), *Walker* 5928 (P), *W. Jeffcott* s.n. (B), *W. Robinson* 35 (K); **Singapore**, *Brehmer* 544 (B), *E. Zogg & H. Gassner* 7312 (L), *F. Kehding* 3026 (P), *Metten* 231 (B), *Th. Wongprasert* s.n. (BKF), *Wallich* 374 (BM, BR, E, K, P), *Wallich* 1822 (BM); **Sumatra**, *A.H.G. Alston* 14364 (BM), *Burchard* 2 (E, P), *Bünnemeijer* 3120, 3233, 7385 (L), *Burchard* 2 (L), *C.J. Brooks* 89S (P), *C.J. Brooks* s.n. (BM), *D. Darnaedi* 88 (L), *E. Gardette* 192, 382, 392, 458 (K, L), *H.C. Robinson and C.B. Kloss* s.n. (BM), *H. Beukema* HB 256, HB 278, HB 280 (L), *H.O. Forres* 3026a (BM), *H. Surbeck* 773 (L), *H. Surbeck* 1240 (L), *H.S. Yates* 2345 (P), *J. Dransfield* 3153 (K, L), *Kostermans* 22070 (L), *P. Buwalda* 6438, 7099 (K, L), *W.J.J.O. de Wilde and B.E.E. de Wilde-Duyffes* 18157 (L), *W. Takeuchi, Z. Efendi, D. Junaidi* 18669 (L); **Borneo**, *Arifin & Ambri* AA405 (K, L), *B.L. Burtt and P.J.B. Woods* B1869 (E), *Burbidge* s.n. (BM, K), *Hallier* 623 (L), *J.P. Mogeia and W.J.J.O. de Wilde* MOGEA 3500 (L), *J.W. Purseglove* P. 5580 (L), *K. Iwatsuki, M. Kato, G. Murata & Y.P. Mogeia* B-711 (L), *K. Iwatsuki, M. Kato, G. Murata & Y.P. Mogeia* B-744 (K, L), *M. Kato & H. Wiriadinata* B-6325 (L); **Moluccas**, *M. Kato, K. Ueda & U.W. Mahjar* C-2191 (K, L), *M. Kato, K. Ueda & U.W. Mahjar* C-13879 (L).

**38. *Tectaria stenosemioides*** (Alderw.) C. Chr., *Index Filic.*, Suppl. 3: 184. 1934.  
Type: Sumatra, Sibolangit, *Lorzing* 5161 (BO).

*Pleocnemia stenosemioides* Alderw., Bull. Jard. Bot. Buitenzorg, Sér. 3, 2: 164. 1920.

Type: as for above.

*Heterogonium alderwereltii* Holttum, Sarawak Mus. J. 5: 163. 1949; Rev. Fl. Malaya ed. 1, 2: 522, f. 305. 1955 [‘1954’]; K. Iwats., Amer. Fern J. 63(3): 131. 1973; Holttum, Kalikasan 4: 229. 1975; Tagawa & K. Iwats., Fl. Thailand 3(3): 363. 1988; Boonkerd & Pollawatn, Pterid. Thailand: 206. 2000; S. Linds., D.J. Middleton, Boonkerd & Suddee, Thai For. Bull., Bot. 37: 96. 2009. Type: as for *P. stenosemioides*.

*Pleocnemia membranifolia* sensu auct. (C. Presl) Bedd., Handb. Ferns Brit. India, Suppl.: 48. 1892, *pro parte*.

*Rhizome* short, erect, bearing a tuft of fronds at apex; scales basifixed, bicolored, dark brown centrally with paler margin, 5–8 × 1–1.5 mm, linear-lanceolate, apex acuminate, margin hairy. *Fronds* dimorphic, lamina bipinnatifid. *Sterile fronds*; stipes castaneous to dark brown, with short brown hairs throughout, 10.0–19.0 cm long, densely scaly at base; lamina oblong-subdeltoid, 15.0–16.5 × 14.5–16.0 cm; basal pinnae 5.0–8.5 × 2.5–4.0 cm, sessile to shortly stalked, lanceolate-oblong, apex acuminate, base round to unequally cuneate, margin deeply lobed to 1/2–2/3 towards costa, lobes elliptic-oblong, slightly falcate, apex acute to obtuse, margin entire to subcrenate, the lowest basal basisopic lobe reduced, mostly the shortest; lateral pinnae 1–3 pairs, 5.0–6.0 × 1.5–2.0 cm, sessile to shortly stalked, oblong-lanceolate, somewhat slightly falcate, apex acuminate, base round to subtruncate or fused with costa, margin deeply lobed to 1/2 towards costa, lobes elliptic-oblong, apex acute, margin entire, proliferous bulbils on rachis sometimes present; terminal pinna 8.0–11.0 × 7.0–9.0 cm, ovate-subtriangular, apex acuminate, base cuneate, margin deeply lobed to 4/5 towards costa, lobes oblong-lanceolate, apex acute to acuminate, margin broadly crenate; texture papyraceous, pubescent on both surface, densely hairy at rachis, costa and main veins, veins anastomosing forming costal areoles, otherwise free, forked, costal areoles lacking free veinlet included. *Fertile fronds*; stipes castaneous to dark brown, with short brown hairs throughout, 22.0–32.5 cm long, densely scaly at base; lamina much contracted, 7.0–14.5 × 5.5–11.5 cm, ovate-subdeltoid; basal pinnae 4.0–6.0 × 0.5–2.0 cm, shortly stalked, lanceolate-falcate, apex acuminate, base cuneate, margin deeply lobed to 1/2–2/3 towards costa, lobes oblong-falcate, apex acute, margin crenate; lateral pinnae 1–2 pairs, 3.5–5.0 × 0.3–0.8 cm, lanceolate-falcate, apex acuminate, base cuneate or fused with costa, margin deeply lobed to 1/2 towards costa, lobes lanceolate-oblong, apex acute, margin minutely crenate; terminal pinna 4.0–10.0 × 3.5–5.5 cm, ovate-subdeltoid, apex acuminate, base cuneate, margin deeply lobed to 4/5 towards costa, lobes lanceolate-falcate, apex acute, margin subentire to crenate; texture papyraceous, pubescent on both surface, densely hairy on rachis, costa and main veins; veins all free, simple, pinnate. *Sori* round, terminal on veinlets, or extending along veins, or sometimes forming coenosori; indusia round-reniform, dorsifixed, stiff, glabrous, caducous. **Fig. 4.38.**

Thailand.— PENINSULAR: Phangnga (Khao Ta Pae, Tham Nam Phud; Sra Nang Manora Forest Park).

Distribution.— Vietnam, Malesia [Peninsular Malaysia, Sumatra (type), Sulawesi].



Ecology.— Terrestrial on humus-rich calcareous soil, in shaded area at 200 m alt.

Note.— Very similar to *Tectaria nayarii* Mazumdar in appearance but differing in its sori that are usually round shape and indusiate.

Specimens examined.— **THAILAND:** Phangnga, Mueang Phangnga, Sra Nang Manora Forest Park, 8° 30' 42" N 98° 32' 23" E, 16 Sep. 2010, *D.J. Middleton, K. Bunpha, P. Karaket, S. Lindsay, T. Phutthai, S. Suddee, N. Tetsana* 5439 (E); Phangnga, Mueang Phangnga, Khao Ta Pae, Tham Nam Phud, 200 m, 17 May 2012, *T. Boonkerd et al.* 2011-566 (BCU);

**MALESIA: Peninsular Malaysia,** *A.S. Abdullah* 596 (BKF), *A.S. Abdullah* 600 (L), *C.G. Matthew* s.n. (K), *Dr. King's Collector* 465 (K), *Dr. King's Collector* 7081 (K), *D.W. Lee* UL-69 (K); **Sumatra,** *J.A. Lörzing* 16102 (K, L), *W.J.J.O. de Wilde and B.E.E. de Wilde-Duyfjes* 16951, 19333 (L).

**39. *Tectaria subpedata*** (Harr.) Ching, *Sinensia* 2(2): 23. 1931; Tardieu & C. Chr., *Fl. Indo-Chine* 7(2): 407. 1941; Dickason, *Ohio J. Sci.* 46(3): 121. 1946; F.W. Xing, Y.H. Yan, S.Y. Dong, F.G. Wang, Christenh. & Hovenkamp, *Fl. China* 2–3: 744. 2013. Type: China, Taiwan, near Kaohsiung (Takow), *Steere* s.n. [holotype MICH! (photo seen MICH 1190768), isotype K! (K001080718)].

*Nephrodium subpedatum* Harr., *J. Linn. Soc., Bot.* 16(89): 30. 1877. Type: as for above.

*Aspidium subpedatum* (Harr.) Diels, *Nat. Pflanzenfam.* 1(4): 186. 1899. Type: as for *N. subpedatum*.

*Sagenia subpedata* (Harr.) Nakai, *Bot. Mag. (Tokyo)* 47: 166. 1933. Type: as for *N. subpedatum*.

*Nephrodium morsei* Baker, *Bull. Misc. Inform. Kew* 1906(1): 11. 1906. — *Aspidium morsei* (Baker) C. Chr., *Index Filic., Suppl.* 1: 8. 1913. — *Tectaria morsei* (Baker) P.J. Edwards ex S.Y. Dong, *Syst. Bot.* 35(2): 241. 2010. — Type: China, Guangxi, Lungchow, *Morse* 51 [holotype K! (K001080726), isotypes K! (K001080725), P! (photo seen P01437224)].

*Rhizome* short, erect to ascending, scaly; *scales* basifixed, bicolored, dark brown centrally with narrowly paler margin, 4–5 × 1–2 mm, linear-lanceolate, apex acuminate, margin entire. Fronds monomorphic; stipes stramineous to dark dull brown, grooved adaxially, 23.0–25.0 cm long, covered with short hairs; lamina simple, 20.0–22.0 × 15.0–16.5 cm, ovate, apex acuminate, base cordate, margin palmately 3-lobed; terminal lobe 17.5–18.5 × 10.5–11.0 cm, elliptic-ovate, apex acuminate, margin entire; pairs of lateral lobes 8.0–11.0 × 3.0–4.0 cm, lanceolate-falcate, apex acuminate, margin entire; chartaceous, glabrous on both surface except few short hairs on midrib and main veins beneath, veins fully anastomosing forming areoles with free included veinlets, veinlets usually forked, costal areoles bearing branched included veinlets. *Sori* round, usually dorsal on anastomosing veins or on coupling veinlets of areoles, arranged in irregularly two rows between main veins; indusia small, round, caducous. **Fig. 4.39.**

Thailand.— NORTH-EASTERN: Loei (Phu Hin Rong Kla National Park).

Distribution.— Myanmar [Shan State (Namhkan)], China (Guangxi), Taiwan (type), N Vietnam.

Ecology.— Terrestrial in shaded places near waterfall in hill evergreen forest at c 1,200 m alt.

Note.— A small population of approximately 20 plants was found at the 8<sup>th</sup> tier of Man Daeng Waterfalls, Dan Sai district, Loei province. The occurrence in north-eastern Thailand conforms to its dispersal in North-eastern Myanmar, South China, Taiwan and North Vietnam and tend to be the southernmost station of this *Tectaria* species.

Specimens examined.— **THAILAND:** Loei, Dan Sai, the 8<sup>th</sup> tier of Man Daeng Waterfalls, c 1,200 m, 9 Jul. 2014, *Sirisak W.* 003 (BCU);

**CHINA:** Guangxi, *Morse* 51 (K, P), *Morse* 75bis (K), *S.P. Ko* 55626 (PE), **Taiwan**, *M.J. Jung* 182 (TAIF), *Steere* s.n. (K, MICH); **VIETNAM:** *Brahure* 4136 (P), *D.K. Harder* 4143 (P), *D.K. Harder, P.K. Loc & T.T. Tai (FIPI)* 4255 (P), *E. Colani* 2830 (P), *L. Averyanov, N.T. Hiep, P.K. Loc* VH4576 (P), *L.Q. Li, N.T. Hiep, Z.Y. Zhang, X.C. Zhang, T.G. Gao, Z.T. Wang, N.S. Khang, N.X. Tam* 0064 (PE), *M. Petelot* 2817 (P), *R. Bonajaite, le Dimauche* s.n. (P).

**40. *Tectaria subvariolosa*** S.Y. Dong, *Phytotaxa* 122(1): 64. 2013. Type: Vietnam, Quang Tri, Vinh Linh (Liem-Cong), *Cadière* 14 [holotype P! (photo seen P01440016), isotypes BM! (BM001048646), P! (photo seen P01440019, P01440022, P01440024, P01440027, P01440029, P01440030)].

*Tectaria stenosemioides* Tardieu & C. Chr., *Notul. Syst. (Paris)* 7: 88. 1938; *Fl. Indo-Chine* 7(2): 420, f. 46, 3–4. 1941; *Holtum, Kew Bull.* 43(3): 482. 1988, *nom. illeg. hom.* Type: as for above.

*Rhizome* short, creeping, up to 10 mm diam. densely scaly at apex; *scales* basifixed, bicolored, dark brown centrally with ferruginous paler margin, 2–5 x 1–2 mm, ovate-lanceolate, apex acute to acuminate, margin hairy. *Fronde* dimorphic, lamina bipinnatifid, sometimes bipinnate at base. *Sterile fronds*, stipes stramineous to pale brown, dull, grooved, 20.0–30.0 cm long, covered with short hairs throughout, scaly at base; lamina ovate-subdeltoid, 23.0–30.0 x 18.0–30.0 cm; basal pinnae 9.0–15.0 x 6.0–12.0 cm, subopposite, stalked, stalk 0.7–1.0 cm long, ovate-subtriangular, apex acute to acuminate, base cordate, margin deeply lobed to 1/2 towards costa, lobes lanceolate-oblong, apex acute to obtuse, margin entire, basisopic lobe or basisopic pinnule usually present, 6.0–10.0 x 1.5–2.5 cm, lanceolate, apex acute, margin subentire to lobed, acrosopic pinnules sometimes present, 1.5–2.5 x 0.7–1.0 cm, lanceolate, apex acute or obtuse, base round to subtruncate, margin entire to slightly crenate, terminal pinnule sometimes present, ovate-lanceolate, asymmetric, apex acute to acuminate, base acute to slightly cuneate, margin deeply lobed to 1/2–2/3 towards costa, lobes lanceolate, apex acute to obtuse, margin entire to crenate; lateral pinnae 1–2 pairs or none, opposite or subopposite, shortly stalked or sessile upward, stalk 0.1–1.0 cm long, 8.0–13.0 x 1.5–4.0 cm, lanceolate, apex acuminate, base cordate, margin crenate to deeply lobed to 1/2 towards costa, lobes lanceolate, apex acute or obtuse, margin entire, interval 3.0–5.0 cm; terminal pinna 10.0–18.0 x 8.0–14.0 cm, ovate-subtriangular, apex acuminate, base acute to slightly cuneate, margin deeply lobed to 2/3 towards costa, lobes lanceolate, apex acute, margin entire to slightly crenate; *Fertile fronds*, stipes stramineous to pale brown, dull, grooved, 31.0–41.0 cm long, covered with short hairs throughout, scaly at base; lamina ovate-subdeltoid, 13.0–15.0 x 7.0–10.0 cm; basal pinnae 3.5–7.0 x 2.5–5.0 cm, stalked,

stalk 0.2–1.0 cm long, ovate-subtriangular, apex acuminate, base cordate, margin deeply lobed to 1/2–2/3 towards costa, lobes lanceolate, apex acute to obtuse, margin entire, basiscopic lobe usually present, 2.0–3.5 × 0.5–1.0 cm, lanceolate-slightly falcate, apex acuminate, margin shallowly lobed; lateral pinnae 1 pair, opposite or subopposite, shortly stalked, stalk 0.1–0.3 cm long, 2.0–4.0 × 0.5–2.0 cm, lanceolate, apex acuminate, base cordate, margin deeply lobed to 1/2 towards costa, lobes lanceolate, apex acute, margin entire; terminal pinna 4.5–6.5 × 2.5–6.0 cm, ovate-subtriangular, apex acuminate, base cordate, margin deeply lobed to 2/3–3/4 towards costa, lobes lanceolate, apex acute to acuminate, margin crenate to shallowly lobed; chartaceous, pubescent on both surface, covering with short brown hairs on lamina and densely short brown hairs on midrib, main veins and margin, venation fully anastomosing forming areoles with free included veinlets, veinlets usually simple, free veinlets in costal and costular areoles usually absent. *Sori* round, terminal on free included veinlets in areoles and on outer veins of costal and costular areoles, one in each areole, arranged in two rows between main veins; indusia round-reniform, thin, bearing short hairs on upper surface, peltate, persistent. **Fig. 4.40.**

Thailand.— NORTHERN: Chiang Mai (Chiang Dao Wildlife Sanctuary); NORTH-EASTERN: Phetchabun (Nam Nao National Park).

Distribution.— Vietnam (type).

Ecology.— Terrestrial in shady places in deciduous forest at 900 m alt.

Note.— Similar to *Tectaria impressa* (Fée) Holttum but differing in its rhizome scales and fronds. Its scales are bicolored and the number and size of pinnae are lower than *T. impressa*.

Specimens examined.— **THAILAND:** Phetchabun, Nam Nao National Park, Tham Por Hong, 17 Oct. 2007, *Kittima, Narumon* KM 681 (KKU); *ibid.*, *Kittima, Narumon* KM 682 (KKU); Chiang Mai, Chiang Dao Wildlife Sanctuary, 22 Dec. 2013, *R. Pollawatn* 1523 (BCU); *ibid.*, *R. Pollawatn* 1530 (BCU); **VIETNAM:** *Cadière* 14 (BM, P), *M. Gaudichaud* s.n. (P), *M. I'Abbé Bon* 9186 (P), *M. Petelot* 5165 (P), *R. P. Bon* 1299 (P).

**41. *Tectaria tenerifrons*** (Hook.) Ching, *Sinensia* 2: 34 1931; Dickason, *Ohio J. Sci.* 46(3): 121. 1946; Holttum, *Dansk Bot. Ark.* 23: 239. 1965; *Ind. Fern J.* 1: 37. 1984; Tagawa & K. Iwats., *Fl. Thailand* 3(3): 377, f. 35. 4–5. 1988; Boonkerd & Pollawatn, *Pterid. Thailand*: 217. 2000; Newman et al., *Checkl. Vasc. Pl. Lao PDR*: 32. 2007; S. Linds., D.J. Middleton, Boonkerd & Suddee, *Thai For. Bull., Bot.* 37: 98. 2009. Type: Myanmar, Moulmein, *C. Parish* 92 [holotype K! (K001080769), isotypes E! (photo seen E00417649), K! (K001080770, K001080771, K001080772, K001080773), P! (photo seen P01548091)].

*Polypodium tenerifrons* Hook., *Sp. Fil.* 4: 104. 1862. Type: as for above.

*Dictyopteris tenerifrons* (Hook.) Bedd., *Ferns Brit. India*: t. 4. 1865; Bedd., *Handb. Ferns Brit. India*: 298. 1892. Type: as for *P. tenerifrons*.

*Rhizome* short, creeping, scaly; *scales* basifixed, concolorous, brown, up to 1 × 0.5 mm, ovate, apex acuminate, margin minutely toothed. Fronds monomorphic, lamina bipinnatifid to bipinnate at base, bipinnatifid upwards; stipes stramineous to pale brown, thin, dull, grooved, 12.0–40.0 cm long, covered with short hairs throughout; lamina ovate-subdeltoid, 9.0–28.0 × 6.0–22.0 cm; basal pinnae 4.0–18.0 × 2.5–9.0 cm, stalked, stalk 0.1–1.5 cm long, ovate-subdeltoid, often falcate, apex

acute to acuminate, base asymmetrically cuneate, margin deeply lobed to 1/2 towards costa or costules, lobes lanceolate, apex obtuse, margin dentate, usually having basal basispic lobes or pinnules, elongate, 1.5–8.0 × 0.5–2.0 cm, lanceolate-falcate, apex acute, margin crenate to deeply lobed to 1/2 towards costae or costules, lobes lanceolate-oblong, apex acute, margin dentate, acroscopic pinnules sometimes present, sessile, 2.0–2.5 × 1.0–1.5 cm, lanceolate, apex acute, base cuneate and fused with costae, margin crenate to shallowly lobed; lateral pinnae 1–2 pairs, gradually becoming smaller upwards, alternate to subopposite, shortly stalked at lower pinnae and sessile upwards, 2.5–11.0 × 1.5–4.0 cm, lanceolate, apex acute to acuminate, base asymmetrically cuneate or fused with costae, margin deeply lobed to 1/2 towards costae, lobes lanceolate, apex obtuse, margin dentate, interval 3.0–4.0 cm; terminal pinna 4.0–15.0 × 2.5–10.0 cm, lanceolate-ovate, apex acute to acuminate, base cuneate, margin deeply lobed to 2/3 towards costa, lobes gradually smaller towards apex, lanceolate, apex acute to acuminate, margin dentate to lobed; herbaceous, pubescent on both surface, covering with short white hairs throughout, densely hairy on costae, costules and midrib, veins partly anastomosing forming areoles without free included veinlets, veins near margin usually free, forked. *Sori* round, dorsal on junction of anastomosing veins or on coupling veinlets, arranged in two rows between main veins; exindusiate. **Fig. 4.41.**

Thailand.— NORTHERN: Mae Hong Son, Chiang Mai (Chiang Dao Wildlife Sanctuary, San Kamphaeng), Nan (Tham Pha Tup Forest Park), Lamphun, Lampang (Doi Pang La, Mae Mo, Tham Pha Thai National Park), Tak (Mae Sot), Nakhon Sawan (Banphot Phisai, Khao Noh-Khao Kaeo, Tham Phet-Tham Thong Forest Park); CENTRAL: Lop Buri (Ban Mi); SOUTH-EASTERN: Sa Kaeo (Khao Chakan), Chantaburi (Kaeng Hang Maeo, Pong Nam Ron); SOUTH-WESTERN: Kanchanaburi (Sai Yok, Tha Po, Thung Kang Yang Hills).

Distribution.— Myanmar [Moulmein (type), Thaton], Laos.

Ecology.— Growing on mountain slopes or limestone rock crevices in light shade at 35–600 m alt.

Note.— This species restricted to seasonal change between dry and rainy season. It has fleshy tuberous rhizome and fronds are seen only in the rainy season.

Specimens examined.— **THAILAND:** Kanchanaburi, 200 m, 15 Jul. 1946, A. *Kostermans* 1153 (BM, L); Nan, Mueang Nan, Tham Phatup Forest Park, trail to Phra Cave, 18° 51' 20" N 100° 44' 5" E, 300 m, 16 Aug. 2012, *D.J. Middleton, P. Karaket, S. Suddee & P. Triboun* 5616 (E, PSU, QBG); Nakhon Sawan, c 160 m, 21 Jul. 1973, *G. Murata, N. Fukuoka & C. Phengkklai* T-16605 (BKF, K); Chiang Mai, Chiang Dao Wildlife Sanctuary, north of Ban Tam, c 490 m, 17 Aug. 1935, *H.B.G. Garrett* 981 (BKF, K); Chiang Mai, San Kamphaeng, Muang Awn Cave, 525 m, 29 Jul. 1989, *J.F. Maxwell* 89-955 (CMU, E, L); Tak, Mae Sot, Mae Kasa, Po Tip Tong Cave, 250 m, 20 Aug. 1994, *J.F. Maxwell* 94-912 (BKF, CMUB, L); Lamphun, Mae Tha, Doi Khun Tan National Park, 550–600 m, 30 Aug. 1994, *J.F. Maxwell* 94-951 (CMUB); Kanchanaburi, Sai Yok, 250 m, 9 Dec. 1961, *K. Larsen* 8630 (K); Kanchanaburi, Thung Kang Yang Hill., 350 m, 7 Feb. 1963, *K. Larsen* 10434 (BKF, K); Rachaburi, near Bang Pong, 250 m, 9 Jul. 1963, *K. Larsen* 10607 (K, L); Mae Hong Son, 500–600 m, 10 Sep. 1974, *K. Larsen & S.S. Larsen* 34340 (BKF, E, K, L, P); Nan, Tham Pha Tok, 350 m, 13 Sep. 1995, *K. Larsen, S.S. Larsen, C. Tange and D. Sookchaloem* 46428 (K, L); Lampang, Tham Pha Thai National Park, 350 m, 23 Sep. 1967, *M.*

*Tagawa, T. Shimizu, H. Koyoma & A. Nalampoon* T-10637 (BKF, L); Chiang Mai, Chiang Dao Wildlife Sanctuary, 500–600 m, 9 Nov. 1967, *M. Tagawa, T. Shimizu, M. Hutoh, H. Koyama and A. Nalampoon* T-9748 (BKF); Chiang Mai, San Kamphaeng, 550 m, 29 Jul. 1998, *P. Palee* 391 (CMUB, L); *ibid.*, 15 Sep. 1998, *P. Palee* 410 (CMUB, L); Mae Hong Son, Tham Phee Man, 19 Jun. 2014, *R. Pollawatn* 1788 (BCU); Lop Buri, Ban Mi, Wat Khao Wongkot, 35 m, 25 Apr. 2004, *R. Pooma, K. Phattarahirankanok, S. Sirimongkol, M. Poopath* 4664 (BKF); Nakhon Sawan, Banphot Phisai, Khao No-Khao Kaeo, 200 m, 19 Oct. 2003, *T. Boonkerd & R. Pollawatn* 427 (BCU); Chanthaburi, Kaeng Hang Maeo, Khao Wong Kot, Tham Tao, 25 Sep. 2011, *T. Boonkerd et al.* 2011-401 (BCU); Chanthaburi, Pong Nam Ron, Nong Tha Kong, Wat Khao Kaeo, 28 Sep. 2011, *T. Boonkerd et al.* 2011-408 (BCU); *T. Boonkerd et al.* 2011-415 (BCU); Sa Kaeo, Khao Chakan, Wat Rattana Khiri, 29 Sep. 2011, *T. Boonkerd et al.* 2011-418 (BCU); Lampang, Ngao, Tham Pha Thai National Park, 394 m, 28 Jul. 2012, *T. Boonkerd et al.* 2011-686 (BCU); Nakhon Sawan, Tak Fa, Tham Phet-Tham Thong National Park, 156 m, 21 May 2013, *T. Boonkerd et al.* 2011-727 (BCU); Uthai Thani, Lan Sak, Wat Khao Pha Rat, 24 May 2013, *T. Boonkerd et al.* 2011-739 (BCU); Lampang, Doi Pang La, Huai Tak, 400 m, 25 Sep. 1967, *T. Shimizu, H. Koyoma & A. Nalampoon* T-10787 (BKF, E, K, L); Lampang, Mae Mo, 600 m, 8 Jan. 1922, *Winit* 1005 (BKF); Nan, Tham Pha Tup, c 300 m, 13 Sep. 1995, *W. Nanakorn et al.* 4246 (QBG);

**MYANMAR:** *Moulmein*, *C. Parish* 84 (BM), *C. Parish* 92 (K, P); **Thaton**, *C.R. Fraser-Jenkins* 32099 (TAIF).

**42. *Tectaria trichotoma*** (Fée) Tagawa, *Acta Phytotax. Geobot.* 25: 180. 1973; Holttum, *Kew Bull.* 43(3): 478. 1988; *Fl. Males.*, Ser. 2, Pterid. 2: 46. 1991. Type: Vietnam, Tourane, *Gaudichaud* 24 [holotype RB! (photo seen RB00543207), isotypes E! (photo seen E00428559, E00428560), K! (K001083082, K001083083, K001083084), MPU! (photo seen MPU015613), NY! (photo seen NY01163542), P! (photo seen P01453195, P01631210)].

*Aspidium trichotomum* Fée, *Mém. Foug.* 5: 295. 1852. Type: as for above.

*Ctenitopsis trichotoma* (Fée) C. Chr., *Notul. Syst.* (Paris) 7: 88. 1938. Type: as for *A. trichotoma*.

*Ctenitis trichotoma* (Fée) Copel., *Gen. Fil.* (Copeland): 125. 1947. Type: as for *A. trichotoma*.

*Dryopteris trichotoma* (Fée) C. Chr., *Index Filic.*, *Suppl.* 3: 100. 1934. Type: as for *A. trichotoma*.

*Dryopteris balabacensis* Christ, *Philipp. J. Sci.* 2: 213. 1907. Type: Philippines, Balabac, *Mangubat* BS392 [holotype P! (photo seen P02142003), isotypes GH! (photo seen GH00076285), K! (K000360809), P! (photo seen P02142001, P02142002, P02142004), NY! (photo seen NY00128186), US! (photo seen US00135227)].

*Ctenitis balabacensis* (Christ) Copel., *Gen. Fil.* (Copeland): 124. 1947; *Fern Fl. Philipp.*: 294. 1960. Type: as for *D. balabacensis*.

*Tectaria balabacensis* (Christ) M.G. Price, *Kalikasan* 1: 37. 1972. Type: as for *D. balabacensis*.

*Dryopteris escriptorii* Alderw., *Bull. Jard. Bot. Buitenzorg* 23: 10. 1916. Type: Philippines, Luzon, Tayabas, Guinayangan, *Escriptor* BS20732 [holotype BO,

isotypes F! (photo seen F0075855F), L, MICH! (photo seen MICH1190427), MO! (photo seen MO-255493), NY! (photo seen NY00128205), P, US! (photo seen US00386231)].

*Rhizome* short, ascending, densely scaly at apex; *scales* basifixed, bicolored, dark brown at central portion with narrow paler margin, 5–8 × 1–2 mm, lanceolate, apex acuminate, margin entire. *Fronde* monomorphic, lamina bipinnate at base, bipinnatifid upwards; stipes dark brown, dull, grooved, 51.0 cm long, covered with short hairs throughout, scaly throughout; lamina ovate, up to 55.0 × 35.0 cm; basal pinnae 17.0–21.0 × 8.0–11.0 cm, subopposite, stalked, stalk 1.5 cm long, ovate-subdeltoid, deeply lobed; basal pinnule 12.0–13.0 × 2.5–3.0 cm, shortly stalked, lanceolate, apex acuminate, base asymmetrically cuneate, margin deeply lobed to 2/3 towards costules, lobes lanceolate-oblong, apex acute, margin slightly crenate; apical pinnule 3.7–4.0 × 1.0–1.5 cm, lanceolate-oblong, apex acute, base acute, margin lobed; terminal pinnule 14.5–18.0 × 10.0–11.0 cm, ovate-subdeltoid, asymmetric, apex acuminate, base asymmetrically cuneate, margin deeply lobed to 4/5 towards costule, lobes lanceolate-oblong, apex acute, margin crenate to lobed, basal basispic lobes the longest; lateral pinnae 8 pairs, alternate to subopposite, stalked at lower pinnae and subsessile upwards, stalks 0.1–1.0 cm long, 9.5–17.0 × 2.0–5.5 cm, lanceolate, apex acuminate, base cordate to asymmetrically cuneate, margin deeply lobed to 4/5 towards costa, lobes lanceolate-oblong, apex acute, margin subentire to crenate, interval 2.5–6.0 cm; terminal pinna 12.5 × 11.5 cm, ovate-subdeltoid, apex acuminate, base cuneate, margin deeply lobed to 2/3 towards costa, lobe lanceolate-oblong, gradually narrowly from base towards apex, apex acute, margin subentire to lobed; chartaceous, glabrous on both surface except few short hairs on sinus, midrib and main veins, veins all free, usually forked. *Sori* round, terminal on short acroscopic branches of veinlets, and sometimes dorsal on veinlets, arranged in two rows between main veins, indusia round-reniform, thin, caducous. **Fig. 4.42.**

Thailand.— SOUTH-WESTERN: Phetchaburi (Kaeng Krachan National Park).

Distribution.— Vietnam (type), Malesia [Philippines (S Luzon, Panay, Sibuyan Islands, Palawan, Balabac), Borneo (Sabah)].

Ecology.— Terrestrial fern in primary evergreen forest at 560 m alt. 12.80° N, 99.4° E.

Note.— It is noted here that Thai specimen kept at BKF (*D.J. Middleton, C. Hemrat, S. Lindsay, S. Suddee & S. Suwanachat* 3324) are similar to specimens from Vietnam in size and it is larger than Malesian specimens.

Specimens examined.— **THAILAND:** Phetchaburi, Kaeng Krachan, Kaeng Krachan National Park, 12.80° N, 99.4° E, 560 m, 5 Sep. 2005, *D.J. Middleton, C. Hemrat, S. Lindsay, S. Suddee & S. Suwanachat* 3324 (BKF);

**VIETNAM:** *A. Baudouin* 393 (P), *Eberhardt* 1697 (P), *Gaudichaud* 24 (E, K, MPU, NY, P, RB), *H. Lecomte & A. Finet* 1242 (P), *J. & M.S. Clemens* 3572 (P), *J. & M.S. Clemens* 4074 (K, P), *Poilane* 1151 (P); **MALESIA:** **Philippines, Luzon, Escritor** BS20732 (BO, F, L, MICH, MO, NY, P, US); **Sibuyan Islands, A.D.E. Elmer** 12237 (K), *C.G. Reynoso, R.A. Espiritu* 118647 (K); **Palawan, s.coll.** SMHI F4 (K); **Balabac, Mangubat** BS392 (GH, K, NY, P, US); **Borneo, Sabah, J.H. Beaman** 9059 (K).

**43. *Tectaria vasta*** (Blume) Copel., Philipp. J. Sci., C 2: 411. 1907; Ching, Sinensia 2(2): 26. 1931; Tardieu & C. Chr., Fl. Indo-Chine 7(2): 416. 1941; Dickason, Ohio J. Sci. 46(3): 121. 1946; Holttum, Rev. Fl. Malaya ed. 1, 2: 512. 1955 ['1954']; Ching, Acta Phytotax. Sin. 8: 151. 1959; Tagawa & K. Iwats., S. E. Asian Stud. 5: 98. 1967; K. Iwats., Amer. Fern J. 63(3): 131, 133. 1973; Tagawa & K. Iwats., Fl. Thailand 3(3): 380. 1988; Holttum, Fl. Males., Ser. 2, Pterid. 2: 92. 1991; I.M. Turner, Gard. Bull. Singapore 47(1): 55. 1995; Boonkerd & Pollawatn, Pterid. Thailand: 164, 218. 2000; S.K. Wu, Acta Phytotax. Sin. 40(6): 532. 2002; S. Linds., D.J. Middleton, Boonkerd & Suddee, Thai For. Bull., Bot. 37: 98. 2009; F.W. Xing, Y.H. Yan, S.Y. Dong, F.G. Wang, Christenh. & Hovenkamp, Fl. China 2–3: 745. 2013. Type: Java, *Blume* s.n. [lectotype (designated here) L! (photo seen L 0052210), paralectotype *Blume* s.n. L! (photo seen L 0063131), P! (photo seen P01437196)].

*Aspidium vastum* Blume, Enum. Pl. Javae.: 142. 1828; Bedd., Handb. Ferns Brit. India: 212, f. 108. 1892. Type: as for above.

*Sagenia vasta* (Blume) T. Moore, Index Filic: 86. 1857. Type: as for *A. vastum*.

*Aspidium alatum* Hook. & Grev., Icon. Filic: 184. 1831; Hook., Sp. Fil. 4: 47. 1862. Type: Bangladesh, Sylhet, *Wallich* 378 [holotype K! (K001080767)].

*Sagenia alata* (Hook. & Grev.) Bedd., Ferns Brit. India: 169. 1866. Type: as for *A. alatum*.

*Aspidium tricuspe* Bedd., Suppl. Ferns Brit. Ind.: 44. 1892. Type: Malaysia, Perak, Gopeng, *Dr. King's collector* 975 [holotype K! (K000236548)].

*Tectaria tricuspis* (Bedd.) Copel., Sarawak Mus. J. 2: 369 1917. Type: as for *A. tricuspe*.

*Tectaria decurrenti-alata* Ching & Wang, Acta Phytotax. Sin. 19: 126. 1981. Type: China, Yunnan, Jinping, *Yunnan Complex Exp.* 931 [holotype PE! (photo seen PE00044735)].

*Rhizome* short, erect, densely scales at apex; *scales* basifixed, bicolored, dark brown centrally with narrowly paler brown edges, 5–10 × 1–3 mm, ovate-subtriangular, apex acuminate, margin subentire. *Fronde*s monomorphic, lamina pinnatifid; stipes and rachis dark dull brown to castaneous, grooved, 30.0–38.0 cm long, winged nearly to the base, wing 1.5–3.5 cm wide, gradually narrowing towards base, scaly at base; lamina 45.0–60.0 × 30.0–35.0 cm, oblong-elliptic in outline; basal pinnae 14.0–30.0 × 5.0–9.0 cm, opposite, elliptic, apex acuminate, margin entire, more or less having basisopic lobe, basisopic lobe 5.0–16.0 × 3.0–4.0 cm, lanceolate-elliptic, apex acuminate, margin entire; lateral pinnae 1–2 pairs, 18.0–30.0 × 3.5–6.0 cm, opposite, oblong-elliptic, apex acuminate, margin entire, interval 8.0–12.0 cm; terminal pinna 18.0–40.0 × 17.0–34.0 cm, ovate-subdeltoid, apex acuminate, margin trilobed, bearing a large middle lobe and smaller adjacent two lobes, middle lobe 15.0–35.0 × 6.5–9.0 cm, elliptic-oblong, apex acuminate, margin entire, pair of adjacent lobes 12.0–30.0 × 3.0–6.5 cm, lanceolate-oblong, apex acuminate, margin entire; texture chartaceous, glabrous on both surfaces except few short hairs on midrib or main veins beneath, veins anastomosing forming many areoles and areolules with free included veinlets, veinlets simple or forked, costal areoles with free veinlets included, veinlets usually forked. *Sori* round, mostly dorsal on anastomosing veins

and somewhat terminal on included veinlets, arranged in two rows between cross veins, scattered throughout abaxially; indusia round-reniform, peltate, stiff, persistent. **Fig. 4.43.**

Thailand.— NORTHERN: Phrae [Rong Kwang (Mae Sai)]; SOUTH-EASTERN: Chonburi (Ban Bueng); PENINSULAR: Surat Thani (Ban Don), Nakhon Si Thammarat (Khao Nan National Park), Yala (Betong, Than To).

Distribution.— India (Assam, Nicobar Islands), Bangladesh (Sylhet, Chittagong), China (Yunnan), Myanmar (Shan State, Kachin State), Laos, Vietnam, Malesia [Peninsular Malaysia, Singapore, Sumatra, Java (type), Borneo, Sulawesi], Papua New Guinea.

Ecology.— Terrestrial in shaded areas near stream banks in evergreen forest at near sea level to 830 m alt.

Note.— This species is similar to *Tectaria fauriei* Tagawa but differing in its equal and larger wing at stipe and rachis and proliferous bulbils on rachis are absent.

Specimens examined.— **THAILAND:** Yala, Than To, Ban Chulaphon Phatthana 7, 155 m, 2 Sep. 2004, *D.J. Middleton, M. Phuphat, R. Pooma & K. Williams* 2860 (BKF); Chon Buri, Ban Bueng, Khao Kheow, 13° 16' N 101° 05' E, 650 m, 18 Sep. 1976, *J.F. Maxwell* 76-647 (BK, L); Yala, Betong, 210–220 m, 3 Aug. 1923, *Put for Eryl Smith* 1840 (K); Surat Thani, Bandon, near sea level, Jun. 1924, *Put for Eryl Smith* 2703 (K); Yala, Betong, Ban Phu Khao Thong, 600 m, 24 May 1993, *T. Boonkerd* 1173 (BCU); *ibid.*, *T. Boonkerd* 1178 (BCU); Nakhon Si Thammarat, Khao Nan National Park, Klong Khan Waterfalls, 390 m, 25 Dec. 2006, *T. Boonkerd, S. Chantanaorrapint & W. Khwaiphon* 318 (BCU); Phrae, Rong Kwang, Mae Sai, 350–830 m, 27 Nov. 1922, *Winit* 965 (BKF, K); Surat Thani, Bandon, 10 Aug. 1993, *W. Somprasong* 328 (BK);

**INDIA: Assam,** *C.B. Clarke* 40841B, 42283A, 42283D, 42283G (K), *C.B. Clarke* 42283H (P), *G. Austeu* 203 (K, P), *Griffith s.n.* (B, K), *G. Mann s.n.* (L, P), *J.C. Prazer s.n.* (B), *J.L. Wenger* 55, 90, 155 (K), *Mishmee s.n.* (K), *Simons* 227 (K); **Nicobar Islands,** *N.P. Balakrishnan* 3974 (K); **BANGLADESH: Sylhet,** *Wallich* 378 (K); **Chittagong,** *C.B. Clarke* 19622 (K, P), *C.B. Clarke* 19697A (K), *J.S. Gamble* 7814 (K), *M.A. Rahman* 2874 (K); **MYANMAR: Shan State,** *J.F. Rock* 2139 (K); **Kachin State,** *J. Keenan, U.T. Aung & U. Tha Hla* 3100 (K); **LAOS: M. Massie s.n.** (P); **VIETNAM: C.W. Chen** Wade1326 (TAIF), *F. Evrard* 559 (K, P), *J. Cadriere s.n.* (P), *L. Pierre* 5724 (P), *Luerssen s.n.* (P), *Poilane* 3799, 7560 (P), *Schmid s.n.* (P); **MALESIA: Peninsular Malaysia,** *A.G. Piggott* 1502, 2171, 2775 (K), *C.B. Robinson* 36 (K), *Dr. King's Collector* 382, 975 (K), *H.F. Comber* 4077 (K), *HNR* 2394 (P), *R.E. Holttum s.n.* (K), *Scortechini s.n.* (B), *W. Avé* 315 (L); **Singapore,** *C.G. Matthew s.n.* (K); **Sumatra,** *C.G.G.J. van Steenis* 862 (L), *E. Gardette* 169, 342 (K), *H. Beukema* HB 166, HB 183 (L), *I.W. Burchard* 28 (L, P), *J. A. Lörzing* 6617, 12805 (L), *Kosthals s.n.* (L); **Java,** *A. Baudouin* 315 (P), *Blume s.n.* (L, P), *Danser* 6313 (L), *Hallier* 699 (K), *H. Lijot* 51 (B), *Miquel s.n.* (K), *Raciborski* 31 (P), *Zollinger* 1669 (B, P); **Borneo,** *A.D. Poulsen* 138 (K), *A. Kalat* ARK 100 (L), *C.J. Brooks s.n.* (L), *D. Vriese* 54 (L), *E. Jiyöberg* 8 (P), *Grabowsky s.n.* (B), *H.F. Comber* 4077 (K), *J. Dransfield & D. Sacrudin* 2169 (L), *Kodoh & P. Lasan* SAN 87530 (L), *Kosterman* 10554B (L), *Kosthals s.n.* (L), *K. Iwatsuki, M. Kato, G. Murata & Y.P. Moge* B-762, B-3209 (L), *M. Kato & H. Wiriadinata* B-4821 (L), *Molly* 854



(B), Y.S. Chao Chao2385 (TAIF); **Sulawesi**, S. Prawiroatmodji & S. Soewoko 1903 (L), W. Meijer 10972 (L).

**44. *Tectaria zeilanica*** (Houtt.) Sledge, Kew Bull. 27: 422. 1972; Sledge, Bot. J. Linn. Soc. 84: 18. 1982; C.M. Kuo, Taiwania 30. 29. 1985; M.G. Price, Contr. Univ. Michigan Herb. 16: 199. 1987; Holttum, Fl. Males., Ser. 2, Pterid. 2: 75. 1991; I.M. Turner, Gard. Bull. Singapore 47(1): 55. 1995; Subh. Chandra, Taiwania 45(1): 57. 2000; Subh. Chandra, Fraser-Jenk., Alka Kumari & Archana Sriastava, Taiwania 53(2). 197. 2008; S. Linds., D.J. Middleton, Boonkerd & Suddee, Thai For. Bull., Bot. 37: 98. 2009; Fraser-Jenk., Bull. Natl. Mus. Nat. Sci., Ser. B 38(4). 177. 2012. Type: Sri Lanka, *Thunberg* s.n. [holotype SBT! (photo seen SBT10556)].

*Ophioglossum zeilanicum* Houtt., Nat. Hist. 2(14): 43, t. 94, f. 1. 1783. Type: as for above.

*Osmunda trifida* Jacq., Collectanea 3: 281, t. 20, f. 3. 1789, *nom. superfl.* Type: as for *O. zeilanicum*.

*Leptochilus zeylanicus* (Houtt.) C. Chr., Index Filicum fasc. 7: 388. 1906. Type: as for *O. zeilanicum*.

*Quercifilix zeylanica* (Houtt.) Copel., Philipp. J. Sci. 37: 409. 1928; Tardieu & C. Chr., Fl. Indo-Chine 7(2): 440, f. 48. 3–4. 1941; Holttum, Rev. Fl. Malaya ed. 1, 2: 528, f. 310. 1955 [‘1954’]; Dansk Bot. Ark. 20: 31. 1961; Manton, Philos. Trans. Sér. B. 238: 137, 161. 1954; Tagawa & K. Iwats., S. E. Asian Stud. 5: 100. 1967; Fl. Thailand 3(3): 383, f. 36. 4–8. 1988; J.L. Tsai & W.C. Shieh, Fl. Taiwan, ed. 2: 294. 1994; Boonkerd & Pollawatn, Pterid. Thailand: 210. 2000; S.G. Lu & T.Y.A. Yang, Taiwania 50(2): 158. 2005. Type: as for *O. zeilanicum*.

*Acrostichum quercifolium* Retz., Observ. Bot. 6: 39. 1791. Type: Sri Lanka, *Koenig* s.n. [lectotype LD! (photo seen LD1112115), isolectotypes BM! (BM000527746), LINN! (photo seen LINN-HS1622-22)].

*Onoclea quercifolia* (Retz.) Willd., Schrift. Akad. Erf. 1802: 27. 1802. Type: as for above.

*Gymnopteris quercifolia* (Retz.) Bernh. ex Schrad., Neues J. Bot. 1(2): 20. 1806; Hook., Icon. Pl 10: t. 905. 1854; Bedd., Ferns Brit. India: 47. 1863; Handb. Ferns Brit. India: 432, f. 262. 1892. Type: as for *O. quercifolium*.

*Dendroglossa quercifolia* (Retz.) Fée, Mem. Foug., Gen. Filic.: 80, t. 7B, f. 3. 1852. Type: as for *O. quercifolium*.

*Polybotrya quercifolia* (Retz.) Mett., Fil. Lechl. 2: 12. 1859. Type: as for *O. quercifolium*.

*Rhizome* short, creeping, densely scaly; *scales* basifixed, concolorous, dark brown,  $2-5 \times 1-1.5$  mm, ovate, apex acuminate, margin toothed. *Fronde* dimorphic, lamina usually trifoliate, rarely quinquefoliate. *Sterile fronds*: stipes pale stramineous to dull brown, grooved adaxially, 0.5–5.0 cm long, covered with short hairs and dense scales throughout; lamina  $3.0-10.0 \times 3.0-5.0$  cm, lanceolate-subtriangular in outline; basal pinnae  $1.5-2.5 \times 1.5-2.0$  cm, opposite, stipitate, stalk 0.1–0.2 cm long, broadly ovate-triangular, apex acute to obtuse, base round to subtruncate, margin entire; lateral pinnae rarely present, oblong, apex acute to obtuse, margin entire; terminal pinna  $1.5-7.0 \times 1.0-4.0$  cm, elliptic-lanceolate, apex acute to obtuse, base acute to cuneate, margin subentire to lobed to 1/2 way towards costa, lobes oblong-elliptic, apex obtuse, margin entire; chartaceous, pubescent throughout on both surface, densely hairy on midribs and main veins, veins fully anastomosing forming irregular areoles with free included veinlets, veinlets free, simple or forked, costal areoles having branched included veinlets. *Fertile frond*: stipes stramineous to dull brown, grooved adaxially, 8.0–25.0 cm long, covered with short hairs throughout and scales at base; lamina  $3.5-5.0 \times 0.5-1.0$  cm, linear-lanceolate; basal pinnae  $1.0-1.5 \times 0.3-0.5$  cm, opposite, stipitate, stalk 0.1–0.2 cm, lanceolate, apex acuminate, base acute to cuneate, margin entire to crenate, bearing elongate basal basiscopic lobes,  $0.1-0.3 \times 0.1$  cm, lanceolate, apex acute, margin entire; lateral pinnae rarely present, falcate, apex acute, margin entire to crenate; terminal pinna  $3.0-4.5 \times 0.1-0.2$  cm, linear, apex acuminate, base acute to cuneate, margin entire; chartaceous, pubescent throughout on both surface, densely hairy on midribs and main veins, veins inconspicuous. *Sori* acrostichoid abaxially, exindusiate. **Fig. 4.44.**

Thailand.— NORTHERN: Lampang (Mae Long), Phitsanulok (Thung Salaeng Luang National Park); NORTH-EASTERN: Phetchabun (Nam Nao National Park), Loei (Phu Kradueng National Park, Phu Luang Wildlife Sanctuary, Phu Suan Sai National Park); CENTRAL: Lop Buri (Wang Kan Lueang Waterfall), Saraburi (Muak Lek); SOUTH-EASTERN: Chantaburi (Khao Soi Dao Wildlife Sanctuary); SOUTH-WESTERN: Prachuap Khiri Khan.

Distribution.— Mauritius, S India, Sri Lanka (type), China (Yunnan, Guizhou, Guangxi, Hainan, Guangdong, Hong Kong, Fujian, Taiwan), Laos, Vietnam, Malesia (Peninsular Malaysia, Borneo, Philippines), Polynesia.

Ecology.— Terrestrial or growing on muddy rocks in moist and shady places near stream banks in dense evergreen forest or mixed bamboo forest at 150–850 m alt.

Vernacular.— Oak leaf fern.

Uses.— Ornamental plants.

Specimens examined.— **THAILAND:** Saraburi, Muak Lek, c 200 m, 31 Aug. 1924, *A.F.G. Kerr* 9085 (BK, K); Phetchabun, Nam Nao National Park, Sum Bon, 14 Jun. 1964, *Adisai* 762 (BK); Loei, Na Haeo, Phu Suan Sai National Park, Tat Huang Waterfalls,  $17^{\circ} 33' 58''$  N  $100^{\circ} 59' 31''$  E, 585 m, 14 Oct. 2009, *D.J. Middleton*, *P. Karaket*, *S. Lindlay*, *T. Phutthai* & *S. Suddee* 5132 (BKF, E, P, PSU, QBG); Lop Buri, Wang Kan Lueang Waterfalls,  $14^{\circ} 50'$  N  $100^{\circ} 55'$  E, c 150 m, 19 Nov. 1984, *G. Murata*, *C. Phengkklai*, *S. Mitsuta*, *T. Yahara*, *H. Nagamasu* & *N. Nantasan* T-51412 (BKF); Phetchabun, Nam Nao National Park, Huay Hok, 19 Oct. 2009, *Kittima*, *Chureerat* KM 875 (KKU); *ibid.*, Sum Ma Kao, 17 Oct. 2007, *Kittima*, *Jiranan* KM 791 (KKU); *ibid.*, Heaw Sai Waterfalls, 20 May 2005, *Kittima*, *Nucharee* 621 (KKU); *ibid.*, Huai Tob Kob, 19 Oct. 2009, *Kittima*, *Sompis* KM 861 (KKU); *ibid.*, Sum Ma

Kao, 10 Oct. 2008, *Kittima*, *Tichakorn* KM 840 (KKU); Loei, Phu Luang Wildlife Sanctuary, interior of Nam Thop, 400–850 m, 12 Jul. 1965, *M. Tagawa*, *K. Iwatsuki* & *N. Fukuoka* T-1906 (BKF); Phitsanulok, Thng Salaeng Luang National Park, c 300–600 m, 12 Nov. 1965, *M. Tagawa*, *K. Iwatsuki* & *N. Fukuoka* T-2033 (BKF); Loei, Na Haeo, Tad Hueang Waterfalls, 700 m, 10 Jun. 1999, *P. Suksathan* 1734 (QBG); Chanthaburi, Khao Soi Dao Wildlife Sanctuary, 400 m, 4 Apr. 2002, *T. Boonkerd* & *R. Pollawatn* 222 (BCU); *ibid.*, 200–300 m, 16 Jan. 1958, *T. Sørensen*, *K. Larsen*, and *B. Hansen* 426 (K); Lampang, Mae Long, 280 m, 8 Nov. 1922, *Winit* 1025 (BKF, K); Loei, Na Haeo, 550 m, 19 Jan. 1995, *W. Nanakorn et al.* 3749 (QBG);

**INDIA:** *A. Abraham* 56 (K), *Beddome* s.n. (K), **SRI LANKA:** *Bradford* 92 (P), *Calid* 2359 (P), *Catal* s.n. (P), *C.P.* 1319 (K), *C.R. Fraser-Jenkins* 1 (K), *C.W. Hope* s.n. (P), *D.J. Codme* s.n. (P), *F. Ballard* 1008, 1023 (K), *Galle* s.n. (K), *G. Gardner* 13 (P), *G. Gardner* 1319 (K), *G. Wall* 60/97 (P), *H.J. Lam.* 7360 (L), *Jelinek* 54 (P), *Kandy* 429 (P), *Koenig* s.n. (BM, LD, LINN), *Leschenault* 693 (P), *Luerfseu* 132 (P), *M.D. de Hauranne* 603 (P), *O. Posthumus* 2827 (L), *P. Willdenow* 37-2 (P), *R.B. & A.J. Faden* 76/392 (K), *Thunberg* s.n. (SBT), *Thwaites* CP 1319 (P), *Walker* s.n. (K), *W.A. Sledge* 507 (K), *W. Robinson*, *C.B.* 29 (K); **VIETNAM:** *A. Cadriere* 55 (P), *B. Balansa* 1967 (P), *B. Doubles* 87 (P), *Cavalerie* 3558 (K), *D' Simond* s.n. (P), *Eberhardt* 212 (P), *M. d' Alleizette* s.n. (P), *M. Gaudichaud* 38 (P), *M. I' Abbé Bon* 9024 (P), *M. Pételot* 661, 5606 (P), *P. Cadriere* 37 (P), *Poilane* 5168, 7930, 7954 (P), *Pócs* 3193/b (P), *R. Brochure* 4136 (P), *W.T. Tsang* 30325 (K, L, P); **MALESIA:** **Borneo**, *Hose* s.n. (P); **Philippines**, *John Walton* s.n. (P); **CHINA:** **Yunnan**, *A. Henry* 13388 (K, P), *C.W. Wang* 74984, 77751, 79477, 79906 (PE); **Guizhou**, *Cavalerie et Fortunat* 2569 (P), *I. Cavalerie* 98 (P), *J. Esquirol* 2961 (P), *M. Cavalerie* 3558 (P), *M. Hance* 92 (P), *P. Esquirol* s.n. (P), *P.S. Wang* 90468 (L); **Guangxi**, *H.B. Morse* 516 (K); **Hainan**, *C. Henry* s.n. (P), *E. Smith* 1447, 1449, 1450 (K), *F.A. McClure* 7860 (K, P), *G.M. Zhang et D. Li* 175 (PE), *S.K. Lau* 3014, 3733 (P, PE), *S.K. Lau* 4861 (PE), *S.Y. Dong* 1008 (PE), *S.Y. Dong & Z.C. Chen* 182 (PE), *Z.C. Chen* 203 (PE), *W.K. Tsang* 16383, 17208 (K, PE), *X.C. Zhang, G.M. Zhang & D. Li* 1596 (PE); **Guangdong**, *C. Wang* 33104 (PE), *H.Y. Liang* 60249 (PE), *K.K. Tsoong* 938 (PE), *S.P. Ko* 51518 (PE), *Ting & Shih* 1185 (L), *W.Y. Chun* 6513 (PE); **Hong Kong**, *C.G. Matthew* s.n. (K), *E. Bodinier* 1294 (P), *Faber* s.n. (P); **Taiwan**, *C.C. Chuang et M.T. Kao* 3104 (L, TAI), *C.C. Hsu & C.S. Kuoh* 10690 (TAI), *C.S. Kuoh* 4037 (TAI), *C.W. Chen* Wade986 (TAIF), *C.M. Kuo* 1897, 2088, 7424, 15940 (TAI), *F.W. Li* FWL860 (TAIF), *H.C. Lin* 282, 317 (TAI), *J.B. Steere* s.n. (P), *J.J. Chen* 236 (TAI), *J.Y. Hwang & C.Y. Hwang* 13 (TAI), *M.F. Kao* 2936 (TAI), *M.J. Jung* 115, 164, 11531 (TAIF), *M.L. Weng* 2039 (TAI), *M.T. Kao* 6875 (TAI), *P.F. Lu* 380, 1961, 7370, 8767, 8961, 9118, 10520, 11136, 11718, 12219, 14224, 21378, 21740, 21919, 23012, 25476, 26094, 26104, 26304, 26316, 27111 (TAIF), *S. Sasaki* s.n. (TAI), *T. Koyama & Kao* 14247 (TAI), *T.Y. Yang* 35A (TAI), *U. Faurie* 294 (L, P), *U. Faurie* s.n. (L), *Y.H. Chang* 907, 908, 909, 20070722-006 (TAIF), *Y.H. Chang* 910 (TAI).

**45. *Tectaria zippelii*** S.Y. Dong, *Phytotaxa* 178(3): 227. 2014. Type: Indonesia, Irian Jaya, *A. Zippelius* 3 [holotype L! (L 0051695), isotypes L! (L 0051696, L 0051697)].

*Heterogonium novoguineense* Holttum, Kalikasan 4: 221. 1975; Fl. Males., Ser. 2, Pterid. 2: 111. 1991. Type: as for above.

*Rhizome* short, erect, densely scaly at apex; *scales* basifixed, concolorous, dark brown, 4–6 × 0.5–1 mm, linear-lanceolate, apex acuminate, margin hairy. *Fronde*s monomorphic, lamina bipinnatisect; stipes stramineous to pale brown, grooved, 23.0–26.0 cm long, covered with short hairs throughout, scaly at base; lamina elliptic, 30.0–32.0 × 15.0–22.0 cm; basal pinnae usually shorter than upper ones, 8.0–11.0 × 2.0–2.5 cm, stalked, stalk 0.1–0.3 cm long, elliptic-oblong, apex acuminate, base subtruncate, margin pinnatisect to 4/5 towards costa, lobes oblong, apex acute, margin crenate; lateral pinnae 12–15 pairs, alternate, shortly stalked at lower pinnae and sessile upwards, stalks 0.1–0.3 cm long, 3.0–13.0 × 1.0–3.0 cm, elliptic-lanceolate, apex acuminate, base cordate to subtruncate, pinnatisect to 4/5 towards costa, lobes oblong, apex acute, margin crenate, interval 1.0–2.5 cm; terminal pinna 7.0–10.0 × 4.0–4.5 cm, ovate-subdeltoid, apex acuminate, base asymmetrically cuneate, margin deeply lobed to 4/5 towards costa, lobe lanceolate-oblong, sometimes falcate, apex acute or obtuse, margin crenate to lobed; herbaceous to papyraceous, pubescent on both surface, covering with filiform white hairs on main veins and lateral veins, densely hairy on rachis, costae and margin of lamina, veins all free, 6–8 pairs in each lobe of pinnae, elongate to margin. *Fertile fronds* not seen. **Fig. 4.45.**

Thailand.— PENINSULAR: Nakhon Si Thammarat (Khao Nan National Park).

Distribution.— Malesia [Borneo, Sulawesi, Irian Jaya (type)].

Ecology.— Terrestrial in semi-shade and on damp ground in evergreen forest at 250–600 m alt.

Note.— Similar to *T. sagenioides* (Mett.) Christenh. but differing in its texture and a number of pinnae. It was found only at Khao Nan National Park. Fertile specimen was not found. Further fieldworks is needed.

Specimens examined.— **THAILAND:** Nakhon Si Thammarat, Khao Nan National Park, 250–600 m, 10 Jun. 2006, *T. Boonkerd, S. Chantanaorrapint & W. Khwaiphon* 208 (BCU); **MALESIA:** Sulawesi, *E. Hennipman* 6064 (L, U); **Irian Jaya,** Biak Island, *D.F. Grether, W.H. Wagner* 4227 [K (photo)]; **PAPUA NEW GUINEA:** *A. Zippelius* 3 (L).

#### 46. *Tectaria* sp.1

Type: *K. Williams, R. Pooma, M. Poopath, V. Chumchamroon* 1372 (BKF!), Tham Wang Phraya Pichai Songkhram, Nongbua subdistrict, Ratsada district, Trang province, peninsular Thailand.

*Rhizome* erect to ascending, up to 15 mm diam.; scales basifixed, concolorous, dark brown, 3–5 × 1–2 mm, lanceolate, apex acuminate, margin minutely toothed. *Fronde*s monomorphic; stipe dark brown, dull, grooved, 11.0–15.0 cm long, scaly at nearly base; lamina bipinnatifid, ovate-subdeltoid in outline, 18.0–20.0 × 13.0–15.0 cm; basal pinnae asymmetric, 7.5–9.5 × 3.5–5.0 cm, stalked, stalks 0.2–0.5 cm long, ovate, apex acuminate, base cordate to truncate, margin deeply lobed to 1/2–2/3 towards costa, basiscopic lobes much longer than acroscopic lobes; acroscopic lobes 0.3–1.5 × 0.3–0.8 cm, gradually narrow from base to apex of basal pinnae, lanceolate, apex acute, margin subentire to crenate, basal acroscopic lobe usually the longest;

basispic lobes  $0.5\text{--}4.0 \times 0.5\text{--}1.5$  cm, lanceolate-oblong, apex acute, margin slightly crenate to lobed, basal basispic lobe usually shorter than upper ones; lateral pinnae usually absent; terminal pinna  $13.0\text{--}16.0 \times 11.0\text{--}14.0$  cm, ovate-subdeltoid, apex long acuminate, base cordate to shortly cuneate, margin pinnatifid, deeply lobed to  $4/5$  towards costa, gradually narrow from base to apex, lobes  $1.0\text{--}10.0 \times 0.5\text{--}2.5$  cm, lanceolate, apex acute to acuminate, margin crenate to lobed, sometimes entire on upper ones; texture chartaceous, pubescent on both surface, densely hairy at costae, midribs and main veins, two kinds of hairs present, 3-celled setose hairs scattered on lamina, costae, midribs and main veins throughout and 3-celled glandulose hairs present at margin; veins partly anastomosing forming many areoles without free included veinlets, otherwise free, simple or forked. *Sori* round, terminal on veinlets in each lobe, arranged in one row on each side of adjacent veins; indusia round-reniform, stiff, dorsifixed, pubescent, persistent. **Fig. 4.46.**

Thailand.— PENINSULAR: Trang (Ratsada district, Nongbua subdistrict, Tham Wang Phraya Pichai Songkhram, limestone area,  $8^{\circ}00'22''$  N,  $99^{\circ}45'04''$  E).

Distribution.— Endemic (Only known from the type locality).

Ecology.— Growing on limestone rocks at c.60 m alt.

Note.— Similar to *Tectaria stenosemioides* (Alderw.) C. Chr. in appearance but differing in characters of fronds.

Specimens examined.— **THAILAND:** Trang, Ratsada, Nongbua, Tham Wang Phraya Pichai Songkhram,  $8^{\circ}00'22''$  N,  $99^{\circ}45'04''$  E, 60 m, 11 Feb. 2005, K. Williams, R. Pooma, M. Poopath, V. Chumchamroon 1372 (BKF).

#### 47. *Tectaria* sp.2

Type: D.J. Middleton, C. Hemrat, S. Lindsay, S. Suddee & S. Suwanachat 3427 (BKF!), Kaeng Krachan National Park, Kaeng Krachan district, Phetchaburi province, south-western Thailand.

*Rhizome* erect to ascending, up to 30 mm diam.; *scales* basifixed, concolorous, dark brown,  $3\text{--}8 \times 0.5\text{--}1.5$  mm, lanceolate, apex acuminate, margin entire. *Fronds* slightly dimorphic, fertile fronds usually smaller or with narrower pinnae than sterile fronds, up to  $110 \times 65$  cm, lamina bipinnate at base, bipinnatifid upwards; stipe dark brown, dull, grooved, 40.0 cm long in sterile frond and 45.0 cm long in fertile fronds, scaly throughout, scales persistent, concolorous, dark brown,  $6\text{--}12 \times 1.5\text{--}2$  mm, lanceolate, apex acuminate, margin entire; lamina bipinnate at base, bipinnatifid upward, ovate to subtriangular in outline,  $65.0 \times 40.0$  cm in sterile frond and  $47.0 \times 25.0$  cm in fertile frond; basal pinnae  $23.5 \times 13.5$  cm in sterile frond and  $18.0\text{--}21.0 \times 10.0\text{--}11.0$  cm, opposite or subopposite, asymmetric, stipitate, stalks 1.5–2.5 cm long, ovate-subdeltoid in outline, deeply lobed; basal pinnule  $11.0 \times 3.5$  cm in sterile frond and  $8.5\text{--}9.5 \times 2.5\text{--}3.0$  cm in fertile frond, lanceolate-oblong, apex acuminate, base asymmetrically cuneate, margin deeply lobed to  $1/2$  towards costule, lobe lanceolate, apex acute to obtuse, margin entire; apical pinnule  $4.0 \times 1.5$  cm in sterile frond and  $3.5\text{--}4.5 \times 1.0\text{--}2.0$  cm in fertile frond, elliptic-lanceolate or oblong, apex acute, base truncate, margin subentire to slightly crenate; terminal pinnule  $21.0 \times 11.0$  cm in sterile frond and  $15.0\text{--}18.0 \times 7.5\text{--}8.5$  cm in fertile frond, ovate-subdeltoid, asymmetric, apex long acuminate, base cuneate, margin deeply lobed to  $4/5$  towards costa, lobe lanceolate-oblong, apex acute to acuminate, margin subentire to shallowly lobed; lateral pinnae 3 pairs,  $14.0\text{--}21.0 \times 5.0\text{--}6.0$  cm in sterile frond and  $12.0\text{--}15.5 \times$

2.5–5.5 cm in fertile frond, shortly stalked to sessile upwards, elliptic-lanceolate, apex acuminate, base round, margin deeply lobed to 1/2 towards costa, lobes lanceolate, apex acute, margin entire; terminal pinna 21.0 × 11.0 cm in sterile frond and 22.5 × 10.5 cm in fertile frond, ovate-subdeltoid, apex acuminate, base cuneate, margin deeply lobed to 4/5 towards costa, lobes lanceolate-falcate, becoming narrow from base to apex, apex acuminate, margin entire to shallowly lobed; chartaceous, glabrous on both surfaces except few short hairs on sinus, midrib and main veins, veins partly anastomosing forming many areoles mostly on costae and costules, areoles without free included veinlet, otherwise free, simple, costal and costular areoles without free included veinlets. *Sori* round, dorsal on anastomosing veins and on branches of free veins near apices of pinna-lobes, scattered throughout; exindusiate. **Fig. 4.47.**

Thailand.— SOUTH-WESTERN: Phetchaburi (Kaeng Krachan NP).

Distribution.— Endemic (Only known from the type locality).

Ecology.— Terrestrial in primary evergreen forest at 850 m alt. 12.82° N, 99.37° E.

Note.— Similar to *Tectaria multicaudata* (C.B. Clarke) Ching in appearance but differing in its venation pattern and sori. Venation is partly anastomosing to form mostly costal and costular areoles without free included veinlets, otherwise free, simple. Sori are located on anastomosing veins and on branches of free veins near apices of pinna-lobes and exindusiate.

Specimens examined.— **THAILAND:** Phetchaburi, Kaeng Krachan, Kaeng Krachan National Park, Through forest down behind Phanoen Thung Ranger Substation, 12.82° N, 99.37° E, 850 m, 13 May 2005, *D.J. Middleton, C. Hemrat, S. Lindsay, S. Suddee & S. Suwanachat* 3427 (BKF).

#### 48. *Tectaria* sp.3

Type: *T. Boonkerd et al.* 2011-416 (BCU!), Khao Chakan district, Sa Kaeo province, south-eastern Thailand.

*Rhizome* short, erect; scales basifixed, concolorous, dark brown to castaneous, 3–5 × 0.5–1 mm, lanceolate to triangular, apex acuminate, margin entire. *Fronde*s slightly dimorphic, fertile fronds usually smaller or with narrower pinnae than sterile fronds, lamina tripinnatifid at base, bipinnatifid upwards. *Sterile fronds*; stipes stramineous to light brown, glossy, thin, grooved adaxially, 15.0–17.0 cm long in sterile fronds and 21.5–23.0 cm long in fertile fronds, covered with short hairs throughout, scaly at nearly base, scales persistent, concolorous, castaneous, 2–3 × 0.5–1 mm, lanceolate-triangular, apex acuminate, margin entire; lamina ovate-elliptic in outline, 18.0–24.0 × 9.0–16.5 cm in sterile frond and 15.0–17.0 × 8.0–8.5 cm in fertile frond; basal pinnae asymmetric, 7.5–8.0 × 7.0–7.5 cm in sterile frond and 6.3–7.3 × 3.7–4.3 cm in fertile frond, stipitate, stalks 1.0–1.2 cm long, ovate to subtriangular in outline, deeply lobed; basal pinnule 4.8–5.0 × 1.7–2.0 cm in sterile frond and 2.0–2.7 × 1.3–1.5 cm in fertile frond, sessile or shortly stalked, 0.1–0.4 cm long, lanceolate to slightly falcate, apex acute, base rounded to subtruncate, margin deeply lobed to 1/2 towards costule, lobe oblong, apex obtuse, margin entire; apical pinnule 3.0–3.5 × 1.0–1.5 cm in sterile frond and 2.5–2.7 × 0.7–1.0 cm in fertile frond, sessile or shortly stalked, stalk 0.1–0.3 cm long, lanceolate to oblong, apex acute, base asymmetrically rounded, margin deeply lobed to 1/2 towards costule, lobe oblong to subtriangular, apex obtuse, margin entire; terminal pinnule 15.5–16.5 ×

4.3–5.0 cm in sterile frond and 4.3–5.5 × 2.5–3.2 cm in fertile frond, sessile, ovate to subtriangular, apex long acute, base oblique, margin deeply lobed to 4/5 towards costa, lobe oblong, apex acute to obtuse, margin subentire to slightly crenate; lateral pinnae 3 pairs, 4.5–9.0 × 1.8–2.5 cm in sterile frond and 4.0–8.0 × 1.0–2.0 cm in fertile frond, shortly stalked at lower pinnae and sessile upwards, lanceolate-elliptic, apex acute to acuminate, base asymmetrically rounded or fused with costa, deeply lobed to 3/5–4/5 towards costa, lobes oblong, apex obtuse, margin entire; terminal pinna 11.0–12.0 × 6.8–7.5 cm in sterile frond and 2.5–6.5 × 1.8–4.5 cm in fertile frond, ovate to elliptic, apex acuminate, base asymmetrically cuneate, margin deeply lobed to 4/5 towards costa, lobe lanceolate to oblong, apex acute to obtuse, margin lobed to 1/3 towards costa and subentire upwards; chartaceous, pubescent with short brown hairs scattered throughout both on upper surface and lower surface, light green; rachis and costa raised, covered with short brown hairs throughout, veins partly anastomosing forming only costal areoles, otherwise free, forked, all free in fertile fronds; costal areoles lacking free included veinlets. *Sori* round, terminal on free veins, sometimes confined near margin, arranged in two rows between main veins; indusia dorsifixed, stiff, round-reniform, brown, persistent. **Fig. 4.48.**

Thailand.— SOUTH-EASTERN: Sa Kaeo (Khao Chakan).

Distribution.— Endemic (Only known from the type locality).

Ecology.— In crevices of limestone rocks, semi-shade at 60 m alt.

Note.— Similar to *Tectaria devexa* (Kunze) Copel. in appearance but differing in its scales, and fronds. The scales are dark brown to castaneous, lanceolate to subtriangular with acuminate apex and entire margin. Fronds are slightly dimorphic, covering with short brown hairs scattered densely throughout on stipe, rachis, lamina, costa, and costules both upper and lower surface.

Specimens examined.— Sa Kaeo, Khao Chakan, 60 m, May 2011, *T. Boonkerd et al.* 2011-416 (BCU).

#### 49. *Tectaria* sp.4

Type: *T. Boonkerd et al.* 2011-726 (BCU!), Tham Nam Wang Si Thammasokrat, Lan Saka district, Nakhon Si Thammarat province, peninsular Thailand.

*Rhizome* short, erect, scaly at apex; *scales* gradually narrowing from base towards apex, basifixed, bicolored, shining dark brown centrally with paler margin, 3–6 × 1–3 mm, lanceolate to triangular, apex acuminate, margin hairy. *Fronds* slightly dimorphic, fertile fronds usually smaller or with narrower pinnae than sterile fronds, lamina bipinnatifid. *Sterile fronds*; stipes castaneous, glossy, thin, grooved adaxially, up to 33.0 cm long in sterile frond and up to 40.0 cm long in fertile frond, covered with short hairs throughout, scaly at nearly base; lamina ovate-subtriangular in outline, 24.0 × 16.0 cm in sterile frond and 22.0 × 17.0 cm in fertile frond; basal pinnae 9.5–10.5 × 3.5–4.5 cm in sterile frond and 9.0–10.0 × 2.0–2.5 cm in fertile frond, stipitate, stalk 0.2–0.5 cm long, lanceolate, apex acute to acuminate, base rounded, margin deeply lobed to 1/2–2/3 towards costa, lobes oblong-falcate, apex acute to obtuse, margin entire, basal basiscopic lobe mostly the shortest; lateral pinnae 2 pairs, 6.0–9.0 × 1.5–2.0 cm in sterile frond and 6.0–8.0 × 1.2–2.0 cm in fertile frond, shortly stalked at lower pinnae and sessile upwards, lanceolate to elliptic or slightly falcate, apex acute to acuminate, base asymmetrically rounded or fused with costa, margin crenate to lobed, lobes oblong, apex acute to obtuse, margin entire;

terminal pinna  $13.0 \times 10.0$  cm in sterile frond and  $13.5 \times 7.0$  cm in fertile frond, ovate to elliptic, apex acuminate, base acute, margin deeply lobed to 4/5 towards costa or pinnatifid, lobe lanceolate-falcate, apex acute to shortly acuminate, margin entire to slightly crenate; texture herbaceous to papyraceous, glabrous on both surface except few short hairs on midrib or main veins beneath; veins partly anastomosing more or less forming costal areoles, otherwise free, forked; costal areoles lacking free included veinlets. *Sori* elongate only at sinuses near margin and margin reflexed; exindusiate.

**Fig. 4.49.**

Thailand.— PENINSULAR: Nakhon Si Thammarat [Lan Saka (Tham Nam Wang Si Thammasokarat)].

Distribution.— Endemic (Only known from the type locality).

Ecology.— A few plants were found in shady areas of limestone cave, terrestrial or lithophyte in crevices of rocks or wall.

Note.— Similar to *Tectaria nayarii* Mazumdar in appearance but differing in characters of fronds, and sori.

Specimens examined.— Nakhon Si Thammarat, Lan Saka, Tham Nam Wang Si Thammasokarat, 29 Mar. 2013, *T. Boonkerd et al.* 2011-726 (BCU).

**50. *Tectaria* sp.5**

Type: *Kittima* 51 (KKU!), Khao Chong Waterfalls, Na Yong district, Trang province, peninsular Thailand.

*Rhizome* short, erect, densely scales at apex.; *scales* basifixed, bicolored, dark brown centrally with narrowly paler margin, up to 1 mm long, lanceolate, apex acuminate, margin undulate. *Fronde* monomorphic, lamina bipinnate at base, bipinnatifid upwards; stipes stramineous to pale brown, thin, grooved, 5.0–8.5 cm long, scaly at nearly base; lamina  $10.0\text{--}11.0 \times 7.5\text{--}12.0$  cm, ovate-subdeltoid, apex; basal pinnae asymmetric,  $8.5 \times 5.0$  cm, stipitate, stalk up to 0.5 cm long, ovate-subdeltoid in outline, deeply lobed; basal pinnule lanceolate, margin deeply lobed to 1/2 towards costules, lobes oblong-lanceolate, apex acute, margin entire; terminal pinnules  $6.5 \times 3.0$  cm, lanceolate, apex acuminate, base cuneate, margin deeply lobed to 2/3 towards costules, lobes oblong-lanceolate, apex acute, margin entire; lateral pinnae 1–2 pairs,  $5.0\text{--}8.0 \times 2.0\text{--}3.0$  cm, shortly stalked, lanceolate to elliptic-oblong, apex acuminate, base round to cuneate, margin deeply lobed to 1/2 towards costae, lobes oblong-lanceolate, apex acute or obtuse, margin entire; terminal pinna  $8.0 \times 3.5$  cm, lanceolate, apex acuminate, base cuneate, margin deeply lobed to 2/3 towards costae, lobes oblong-lanceolate, apex acute, margin entire; herbaceous, glabrous on both surfaces except few short hairs on sinus, midrib and main veins, veins partly anastomosing forming costal and costular areoles without free included veinlets, otherwise free, forked. *Fertile fronds* not seen. **Fig. 4.50.**

Thailand.— PENINSULAR: Trang (Khao Chong Waterfalls).

Distribution.— Endemic (Only known from the type locality).

Ecology.— No information described its habitat.

Note.— Similar to *Tectaria devexa* (Wall. ex Hook. & Grev.) Copel. but differing in its bicolored scales, and glabrous lamina. This specimen is incomplete, further fieldwork is needed.

Specimens examined.— **THAILAND:** Trang, Na Yong, Khao Chong Waterfalls, *Kittima* 51 (KKU).



### 51. *Tectaria* sp.6

Type: *s.coll.* 21 (KKU!), Along the road from Chum Phae to Lom Sak, Nam Nao National Park, Nam Nao district, Phetchabun province, north-eastern Thailand.

*Rhizome* short, erect, densely scales at apex; *scales* basifixed, concolorous, dark brown,  $2-5 \times 1-2$  mm, lanceolate, apex acuminate, margin minutely toothed. *Fronde*s monomorphic, lamina bipinnate; stipes stramineous to dull brown, grooved, up to 10.5 cm long, scaly at base; lamina  $16.0-20.0 \times 11.0-17.0$  cm, ovate-elliptic in outline; pinnae  $4.0-20.0 \times 2.0-17.0$  cm, gradually smaller from base towards apex, alternate, stipitate, 0.3–1.5 cm long, ovate-elliptic in outline, interval 2.5–4.5 cm; lateral pinnules  $0.5-7.5 \times 0.5-3.0$  cm, alternate or opposite, stipitate, 0.1–1.0 cm long, lanceolate, apex acute to acuminate, base acute to cuneate, margin entire to shallowly lobed to  $1/3-1/2$  towards costules, pinnules at basiscopic side usually larger than ones at acroscopic side, basal basiscopic pinnules of each pinna usually the largest, terminal pinnule  $2.5-7.0 \times 1.0-1.5$  cm, ovate-lanceolate, apex acuminate, base cuneate, margin shallowly to deeply lobed to  $1/2$  towards costule, lobes lanceolate, apex acute to acuminate, margin entire; chartaceous, glabrous on both surfaces except few short hairs on sinus, midrib and main veins, veins anastomosing forming areoles with or without free included veinlets, veinlets free, simple or sometimes forked, free veinlets in costal and costular areoles absent. *Sori* round, terminal on free included veinlets in each areoles or on coupling veins, arranged in two rows between main veins, indusia round-reniform, persistent. **Fig. 4.51.**

Thailand.— NORTH-EASTERN: Phetchabun [Nam Nao National Park (Along the road from Chum Phae to Lom Sak)].

Distribution.— Endemic (Only known from the type locality).

Ecology.— No information described its habitat.

Note.— Similar to *Tectaria laxa* (Copel.) M.G. Price (species from Philippines) but differing in its pinnules and venation pattern. Only one specimen was collected, further fieldwork is needed.

Specimens examined.— **THAILAND:** Phetchabun, Nam Nao, Nam Nao National Park, Along the road from Chum Phae to Lom Sak, *s.coll.* 21 (KKU).

### 52. *Tectaria* sp.7

Type: *T. Boonkerd et al.* 2011-696 (BCU!), Nong Hin district, Loei province, north-eastern Thailand; Paratype: *T. Boonkerd et al.* 2011-629 (BCU!), Nong Hin district, Loei province, north-eastern Thailand.

*Rhizome* creeping, 4–10 mm diam.; scales basifixed, bicolored, dark brown centrally with brown ferruginous margin,  $2-4 \times 0.5-1$  mm, lanceolate to subtriangular, apex acuminate, margin fimbriate. *Fronde*s monomorphic; stipe stramineous to pale brown, dull, grooved adaxially, 9.5–32.5 cm long, scaly at nearly base, scales persistent, concolorous, light brown,  $3.0-5.0 \times 0.5-1.0$  mm, linear to lanceolate, apex acuminate, margin entire; lamina bipinnate at base, bipinnatifid upward, ovate to subtriangular in outline,  $20.0-28.0 \times 20.0-24.5$  cm; basal pinnae asymmetric,  $12.0-14.0 \times 8.0-11.5$  cm, stalked, stalks 0.5–1.5 cm long, ovate to subtriangular in outline, deeply lobed; basal pinnule  $7.5-9.0 \times 2.4-3.2$  cm, lanceolate to oblong, apex acuminate, base asymmetrically cuneate or fused with rachis, margin deeply lobed, lobe subtriangle, apex acute to obtuse; apical pinnule  $4.0-5.6 \times 1.2-2.0$

cm, lanceolate to elliptic, apex acute, base acute to rounded or fused with rachis, margin entire; terminal pinnule  $10.5\text{--}11.5 \times 4.7\text{--}5.7$  cm, elliptic to subtriangle, apex long acuminate, base cuneate, margin deeply lobed to 4/5 towards costa, lobe lanceolate to falcate, apex acute to obtuse; lateral pinnae 1–2 pairs,  $9.0\text{--}13.0 \times 2.0\text{--}3.5$  cm, sessile, lanceolate to falcate, apex long acuminate, base asymmetrically cuneate, acroscopic lobe distantly crenate, basisopic lobe deeply lobed to 4/5 towards costa, lobes falcate, apex obtuse to acute; terminal pinna  $12.0\text{--}16.0 \times 6.0\text{--}10.0$  cm, elliptic to triangular, apex long acuminate, base cuneate to decurrent, margin deeply lobed to 4/5 towards costa, lobes falcate, apex acute to acuminate, margin entire to slightly undulate; texture herbaceous, hairy at margin, light green; rachis and costa raised, covered with short hairs, to 4/5 towards costa, pubescent only at sinus, rachis and costa, lower surface glabrous, veins anastomosing forming many areoles with or without included free veinlets, veinlets free, simple. *Sori* round, terminal on free veinlets, arranged in two rows between main veins, sometimes confined near margin; indusia round-reniform, dorsifixed, stiff, brown, persistent. **Fig. 4.52.**

Thailand.— NORTH-EASTERN: Loei (Nong Hin).

Distribution.— Endemic (Only known from the type locality).

Ecology.— Terrestrial in calcareous soil in crevices of limestone rocks, semi-shade at 750–820 m alt.  $17^{\circ}02'97.83''$  N,  $101^{\circ}73'93.89''$  E.

Note.— Similar to *Tectaria impressa* (Fée) Holttum in appearance but differing in scale and frond characters. Scales are lanceolate to subtriangular with acuminate apex and entire to slightly fimbriate margin. Fronds are monomorphic and herbaceous. Lateral pinnae are lanceolate to falcate with acuminate apex and unequally cuneate base.

Specimens examined.— **THAILAND:** Loei, Nong Hin,  $17^{\circ}02'97.83''$  N,  $101^{\circ}73'93.89''$  E, 750–820 m, 17 Oct. 2012, *T. Boonkerd et al.* 2011-629 (BCU), *ibid.*, *T. Boonkerd et al.* 2011-696 (BCU).

### 53. *Tectaria* sp.8

Type: *O. Ratana* 21 (BCU!), Sunantha Waterfalls, Khao Nan National Park, Nakhon Si Thammarat province, peninsular Thailand; Paratype: *B. Sangkhachard* & *B. Nimanong* 1266 (L!), Waeng district, Narathiwat province, peninsular Thailand.

*Rhizome* ascending to suberect, 1.0–1.3 cm diam.; scales basifixed, concolorous, dark brown,  $4\text{--}6 \times 1\text{--}2$  mm, linear to lanceolate, apex acuminate, margin hairy, hairs filamentous, long. Fronds slightly dimorphic, fertile fronds usually smaller or with narrower pinnae than sterile fronds, lamina simple, entire; stipes stramineous to pale brown, dull, grooved adaxially, 3.5–9.0 cm long in sterile frond and up to 18.5 cm long in fertile frond, scaly at base; scales persistent, concolorous, dark brown,  $3\text{--}4 \times 0.5\text{--}1$  mm, linear to lanceolate, apex acuminate, margin subentire to fimbriate, hairs filamentous, shorter than margin of rhizome scales; lamina  $13.5\text{--}28.0 \times 5.0\text{--}8.0$  cm in sterile frond and  $15.0 \times 4.5$  cm in fertile frond, elliptic to oblong, apex acuminate, base acute to slightly cuneate, margin entire, upper surface glabrous and lower surface pubescent, having short hairs scattered throughout, venation fully anastomosing forming many areoles and areolules with free included veinlets, veinlets simple or forked, costal areoles having a few simple veinlets. *Sori* usually confluent, elongate on anastomosing veins, or sometimes rounded, arranged into three to four rows between main veins; exindusiate. **Fig. 4.53.**

Thailand.— PENINSULAR: Nakhon Si Thammarat [Khao Nan National Park (Sunantha Waterfalls)], Narathiwat (Waeng).

Distribution.— Endemic.

Ecology.— Terrestrial in shady places in evergreen forest at 100 m alt.

Note.— Similar to *Tectaria singaporiana* (Wall. ex Hook. & Grev.) Copel. in appearance but differing in its scales, fronds, and sori. The margin of scales has long filamentous hairs, in contrast to hairy margin in scales of *Tectaria singaporiana*. Frond is slightly dimorphic. Its lamina has short hairs scattered throughout abaxially. Sori are elongate on anastomosing, usually confluent and exindusiate.

Specimens examined.— **THAILAND:** Narathiwat, Waeng, 24 Aug. 1966, *B. Sangkhachard* & *B. Nimanong* 1266 (L), Nakhon Si Thammarat, Khao Nan National Park, Sunantha Waterfalls, 100 m, 11 Mar. 2006, *O. Ratana* 21 (BCU).

#### 54. *Tectaria* sp.9

Type: *T. Boonkerd et al.* 2011-535 (BCU!) Loei, Nong Hin, Bodhisattva Cave, 4 Apr. 2012, Nong Hin district, Loei province, north-eastern Thailand.

*Rhizome* short, ascending to short-creeping, densely scaly at apex; scales basifixed, bicolored, dark brown at central portion with paler ferruginous margin, 2–3 × 1–1.5 mm, lanceolate, apex acuminate, margin hairy. *Fron*ds slightly dimorphic, fertile fronds usually smaller or with narrower pinnae than sterile fronds, lamina bipinnate at base, bipinnatifid upwards. *Sterile fronds*: stipes stramineous to light brown, up to 45.0 cm long in sterile fronds and up to 58.5 cm long in fertile fronds, scaly nearly base, covered with short hairs; lamina 30.0 × 25.0 cm in sterile fronds and 30.0 × 13.8 cm in fertile fronds, ovate-elliptic in outline; basal pinnae bipinnatifid when young and becoming to bipinnate when mature, 19.0–20.0 × 9.5–11.5 cm in sterile fronds and 12.5–14.5 × 5.5–6.5 cm in fertile fronds, asymmetrical, stipitate, stalk 2.0–3.0 cm long, subopposite, ovate-elliptic in outline; basiscopic pinnule 10.0 × 4.0 cm in sterile fronds and 7.5 × 2.5 cm in fertile fronds, sessile to shortly stalked, oblong-elliptic, apex acute, base oblique, margin deeply lobed with crenulate lobes, lobes 1.5–2.0 × 1.0–1.2 cm, margin entire; acroscopic pinnule 5.5 × 1.8 cm in sterile fronds and 2.5–3.0 × 1.0–1.5 cm in fertile fronds, lanceolate, apex acuminate, base, margin crenulate to shallowly lobed; terminal pinnule 15.5–16.0 × 8.0–9.0 cm in sterile fronds and 9.0–9.5 × 4.5–5.0 cm in fertile fronds, pinnatifid, apex acuminate, base cuneate to slightly attenuate, margin deeply lobed to 1/2 way towards costules, lobes oblong-lanceolate, apex round, margin entire to crenate; lateral pinnae 2 pairs, 11.8–15.0 × 4.7–5.5 cm in sterile fronds and 7.0–9.0 × 3.5–4.5 cm in fertile fronds, asymmetrical, stipitate, 0.7–0.8 cm long in lower lateral pinnae and 0.2–0.3 cm long in upper lateral pinnae, alternate or subopposite, ovate-lanceolate, apex acuminate, base asymmetrical cordate, margin deeply lobed, lobed to 1/2 way towards costa, asymmetrical, basal basiscopic lobe the longest, 1.2–3.4 × 0.5–1.5 cm in sterile fronds and 2.0–3.5 × 1.0–1.5 cm in fertile fronds, margin entire to narrowly crenate; terminal pinna pinnatifid, 14.3 × 10.2 cm in sterile fronds and 9.5 × 7.0 cm in fertile fronds, ovate, deeply lobed, lobed 1/2 to 2/3 towards costa, margin subentire to shallowly lobules; chartaceous, light green, glabrous except a few hairs on sinus, midrib and main veins beneath, veins anastomosing to form areoles with free included veinlets, veinlets simple, costal areoles more or less having free included veinlets. *Sori* round,

terminal on free included veinlets in areoles, arranged in two rows between main veins; indusia round-reniform, brown, peltate, stiff, persistent. **Fig. 4.54.**

Thailand.— NORTH-EASTERN: Loei [Nong Hin (Bodhisattva Cave)].

Distribution.— Endemic (Only known from the type locality).

Ecology.— Terrestrial on calcareous soil, in semi-shaded area.

Note.— Similar to *T. impressa* (Fée) Holttum but differing in its fronds. Long basal basiscopic lobes usually present in all pinnae and free veinlets in costal and costular areoles are often present.

Specimens examined.— **THAILAND:** Loei, Nong Hin, Bodhisattva Cave, 4 Apr. 2012, *T. Boonkerd et al.* 2011-535 (BCU).



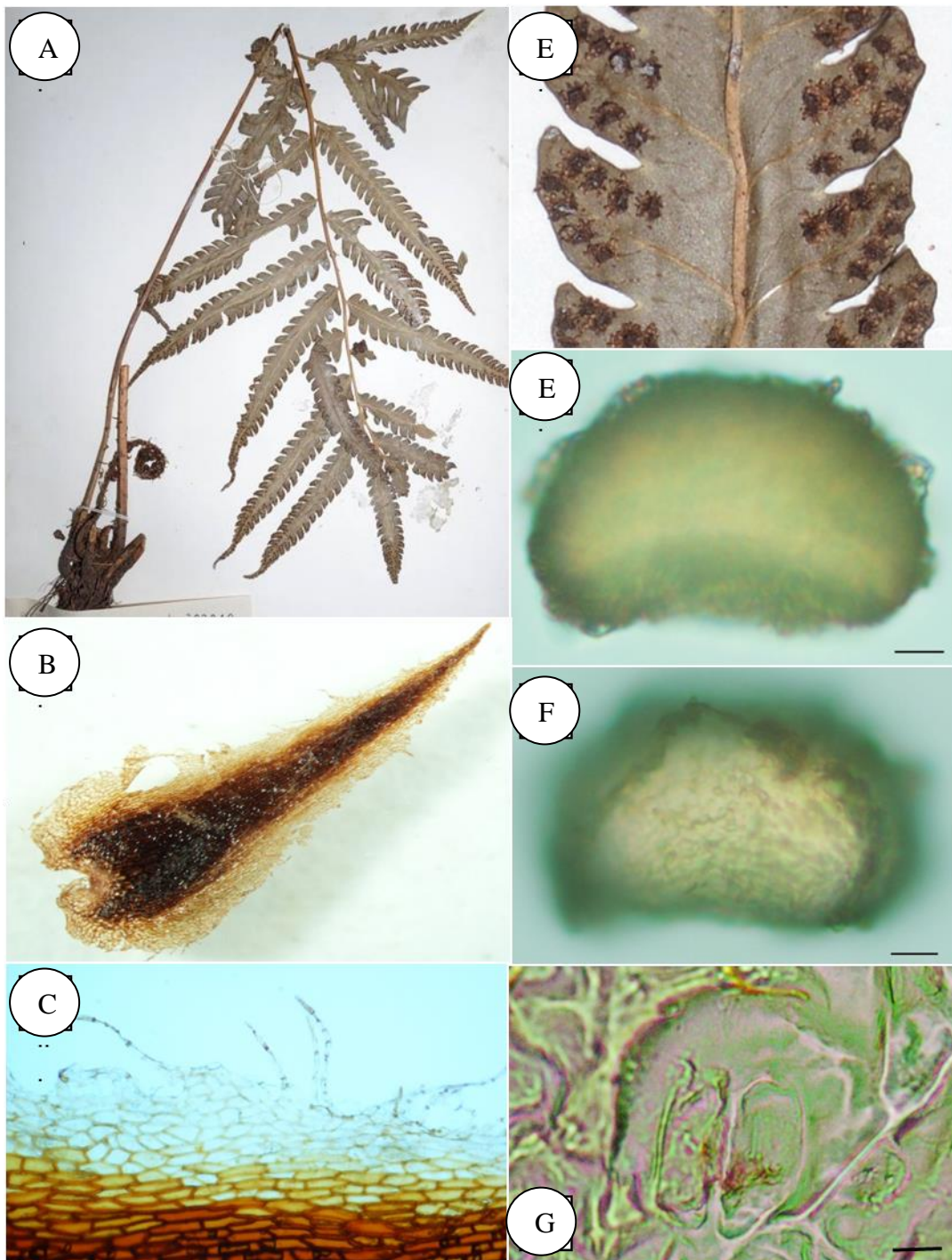


Fig. 4.1 *Tectaria acrocarpa*

A. habit, photo was taken from *T. Boonkerd* 1577 (BCU), only once collected from Doi Phu Kha National Park, Nan province; B. scale; C. scale margin; D. sori; E. spore (optical section); F. spore (ornamentation); and G. stoma (bar = 1 mm in B., 5  $\mu$ m in E. & F., and 10  $\mu$ m in G.).



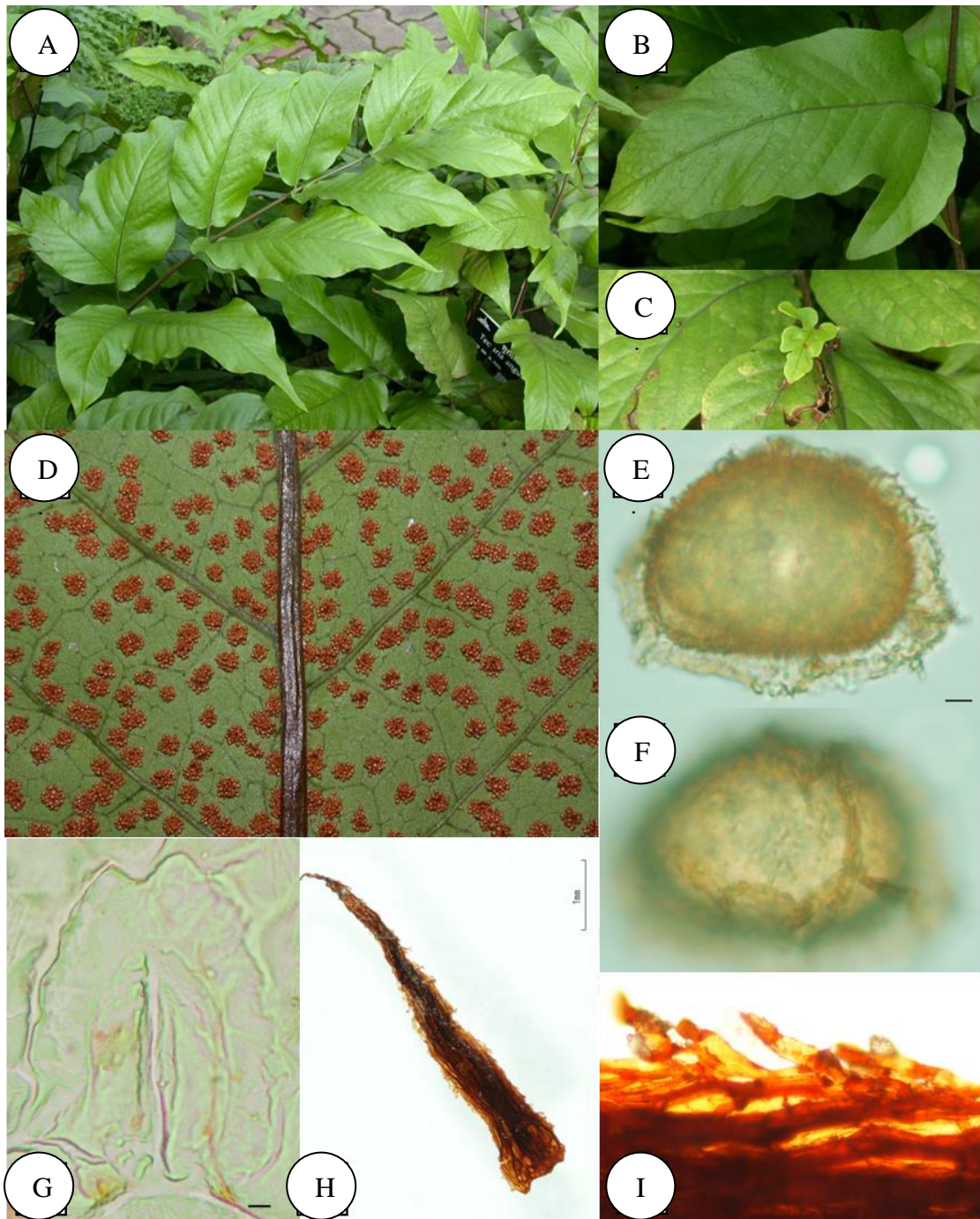


Fig. 4.2 *Tectaria angulata*

A. natural habitat, cultivated plant at Suan Luang Rama IX, Bangkok; B. basal pinna; C. proliferous bulbil; D. sori; E. spore (optical section); F. spore (ornamentation); G. stoma; H. scale; and I. scale margin (bar = 5  $\mu$ m in e., f. & g., 1 mm in h.).

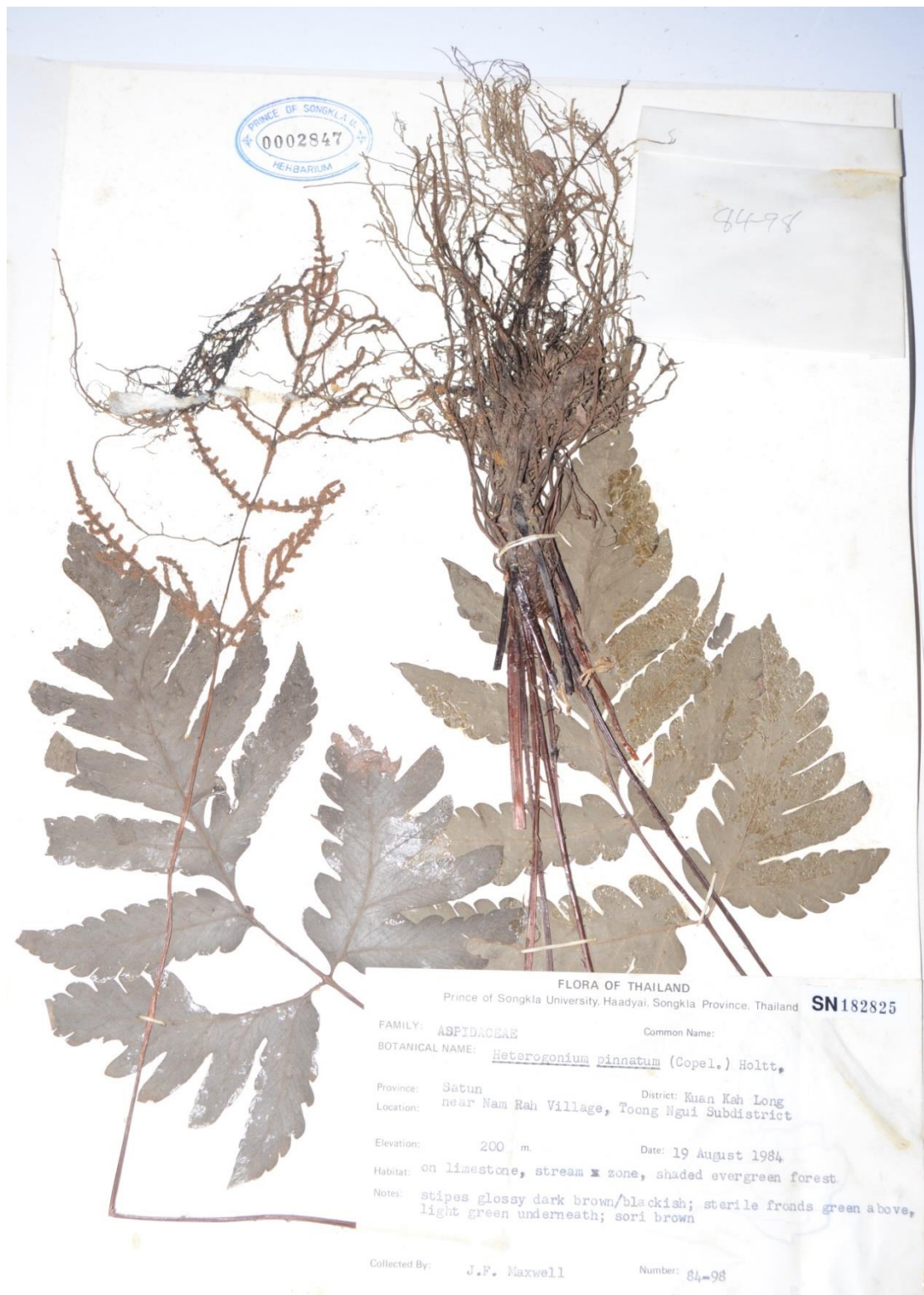


Fig. 4.3 *Tectaria aurita*  
habit, photo was taken from *J.F. Maxwell* 84-98 (PSU), only once specimen from  
Kuan Kalong district, Satun province.



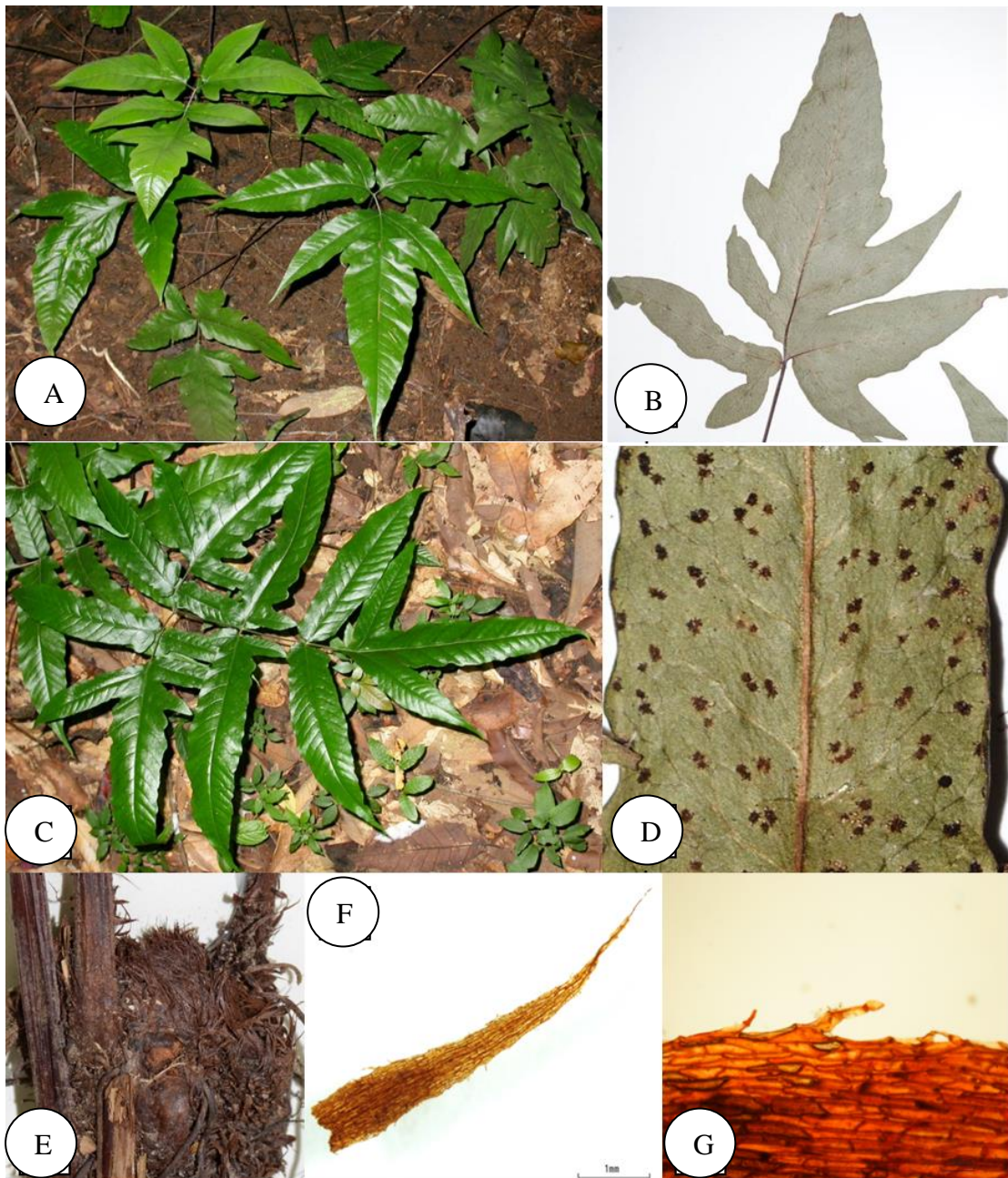


Fig. 4.4 *Tectaria barberi*

A. natural habitat from Khao Nan National Park, Nakhon Si Thammarat province; B. young frond; C. mature frond; D. venation pattern and sori; E. rhizome with scales at apex; F. scale; and G. scale margin [B., F. & G. from *T. Boonkerd*, *S. Chantanaorrapint*, *W. Khwaiphon* 394 (BCU); D. from *M. Stankovic*, *K. Jamtsho* & *B. Hassama* 45 (PSU); E. from *E. Smith* 2687 (K); bar = 1 mm in F., and 100  $\mu$ m in G.].



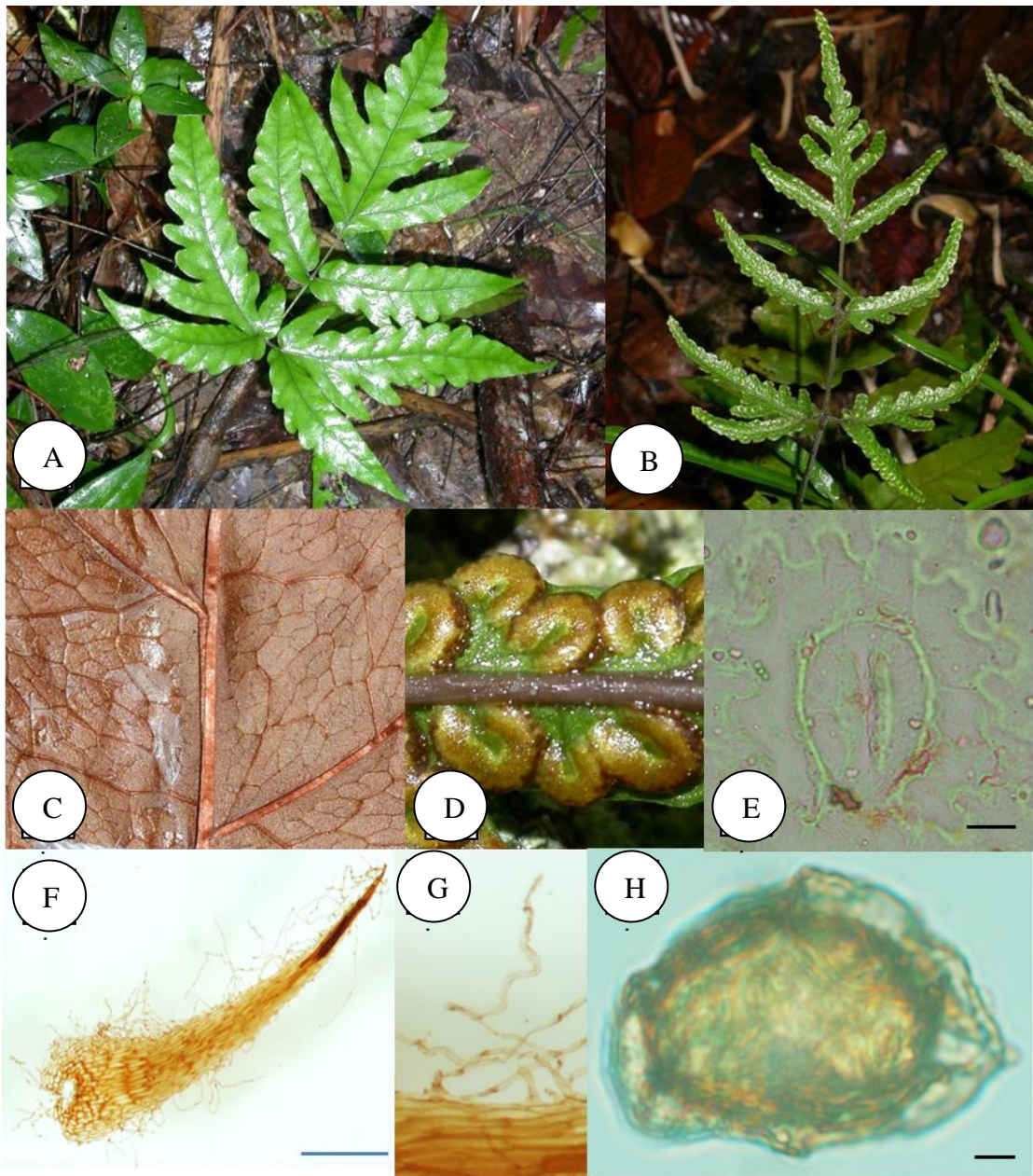


Fig. 4.5 *Tectaria brachiata*

A. sterile frond; B. fertile frond, A. & B. from Ko Samui, Surat Thani province; C. costal areoles with free included veinlets; D. sori; E. stoma; F. scale; G. scale margin with hairs; and H. spore; C. from *J.F. Maxwell* 86-1102 (PSU).



Fig. 4.6 *Tectaria chattagramica*

A. habit; B. scales covering rhizome apex; and C. sori [photos were taken from *B. Hansen, G. Seidenfaden and T. Smitinand 11254 (K)*].



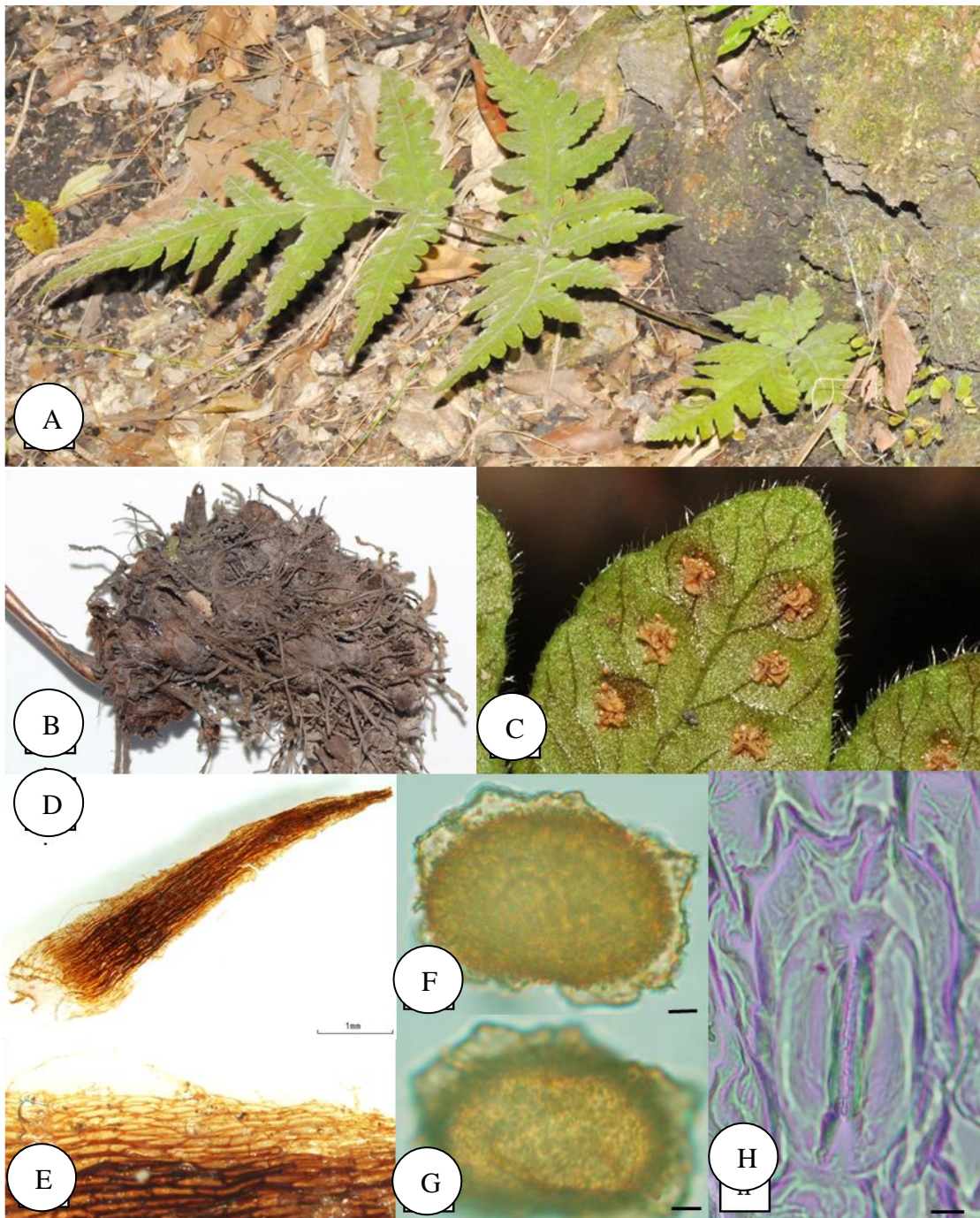


Fig. 4.7 *Tectaria coadunata*

A. natural habitat from Chiang Dao Wildlife Sanctuary, Chiang Mai province; B. rhizome; C. sori; D. scale; E. scale margin; F. spore (optical section); G. spore (ornamentation); H. stoma [photos were taken from *R. Pollawatn* 1588 (BCU), bar = 1 mm in D., 200 µm in E., 5 µm in F. & G., and 10 µm in H.].

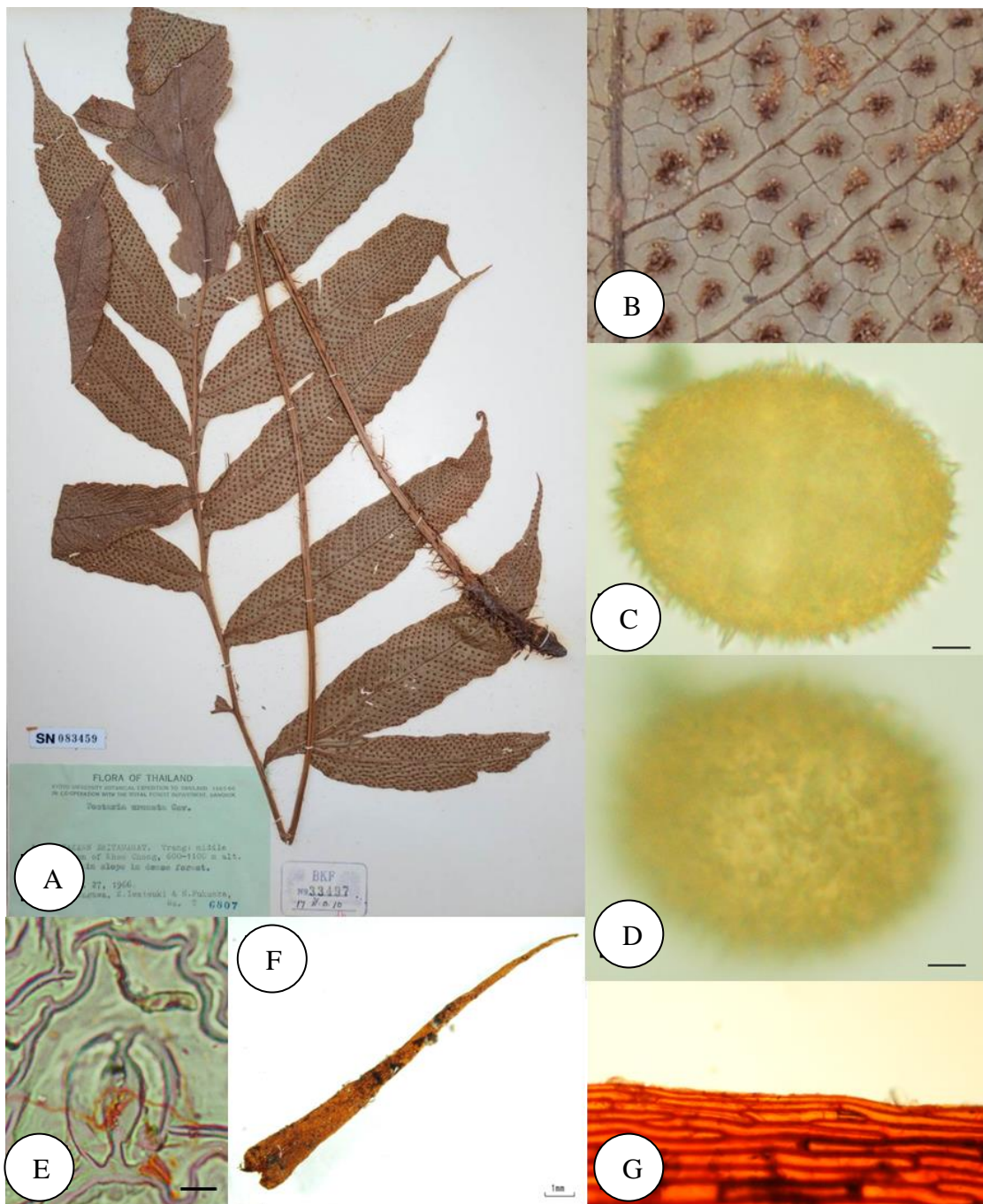


Fig. 4.8 *Tectaria crenata*

A. fertile frond; B. position of sori; C. spore (optical section); D. spore (ornamentation); E. stoma; F. scale; and G. scale margin [A. & B. from *M. Tagawa, K. Iwatsuki & N. Fukuoka* T-6807 (BKF), bar = 5  $\mu$ m in C. & D., 10  $\mu$ m in E., 1 mm in F.].



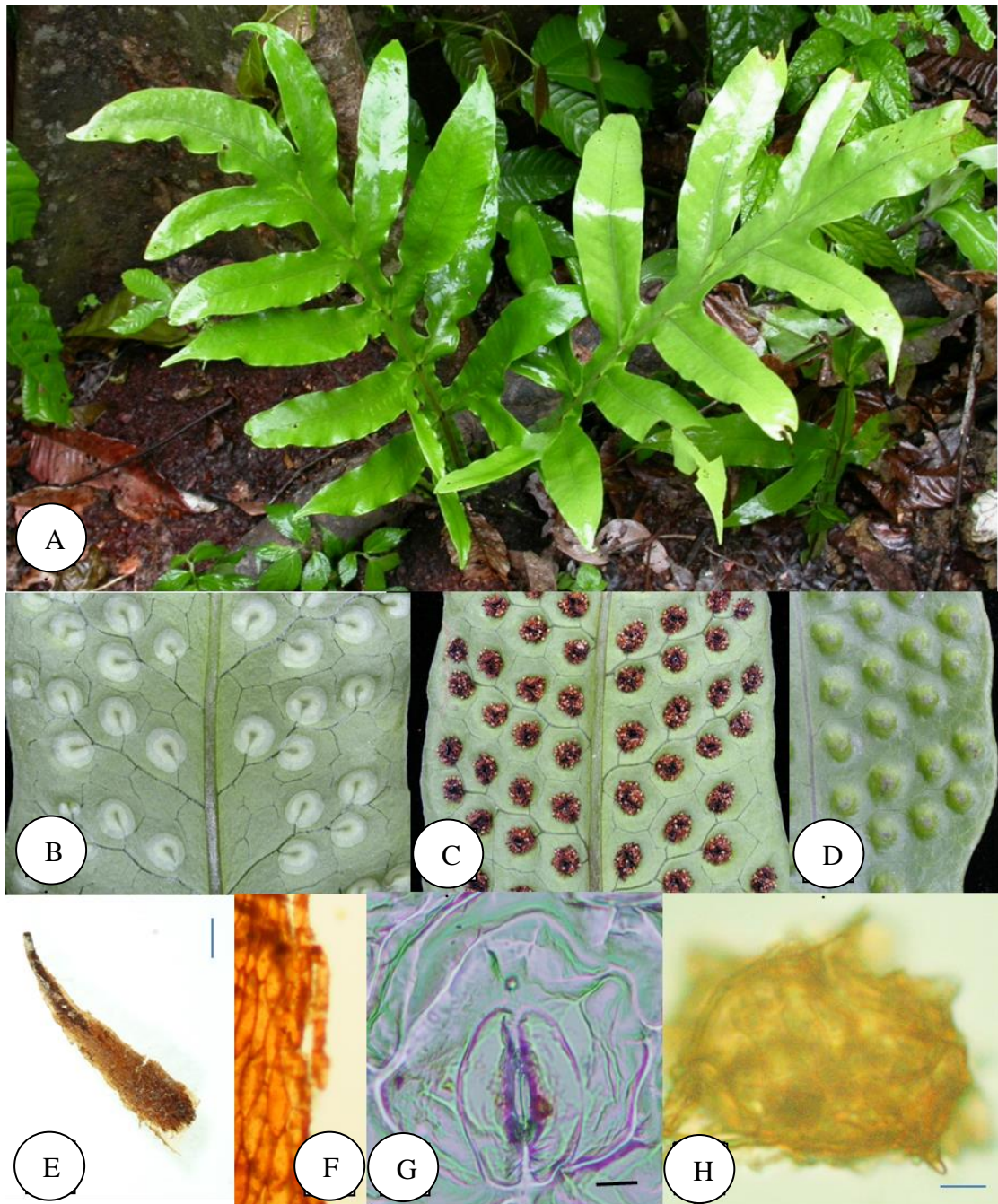


Fig. 4.9 *Tectaria decurrens*

A. natural habitat from Khao Nan National Park, Nakhon Si Thammarat province; B. young sori; C. old sori; D. upper surface of fertile frond; E. scale; F. scale margin; G. stoma; H. spore; [bar = 1 mm in E., 100  $\mu$ m in F., 10  $\mu$ m in G., and 5  $\mu$ m in H.].

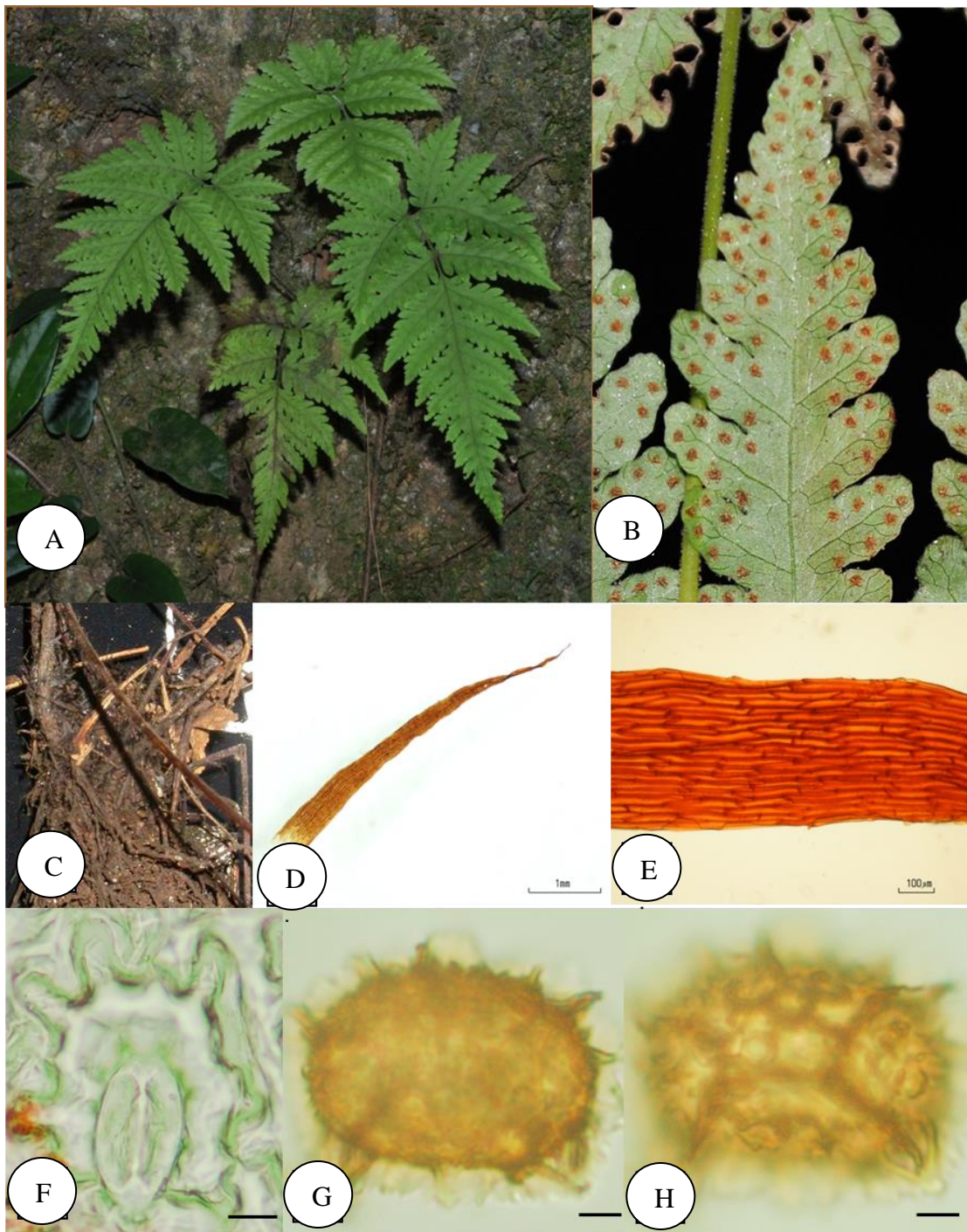


Fig. 4.10 *Tectaria devexa*

A. natural habitat from Khao Nan National Park, Nakhon Si Thammarat province; B. sori; C. rhizome; D. scale; E. scale margin; F. stoma; G. spore (optical section); and H. spore (ornamentation) [bar = 1 mm in D., 100  $\mu$ m in E., 10  $\mu$ m in F., and 5  $\mu$ m in G. & H.].



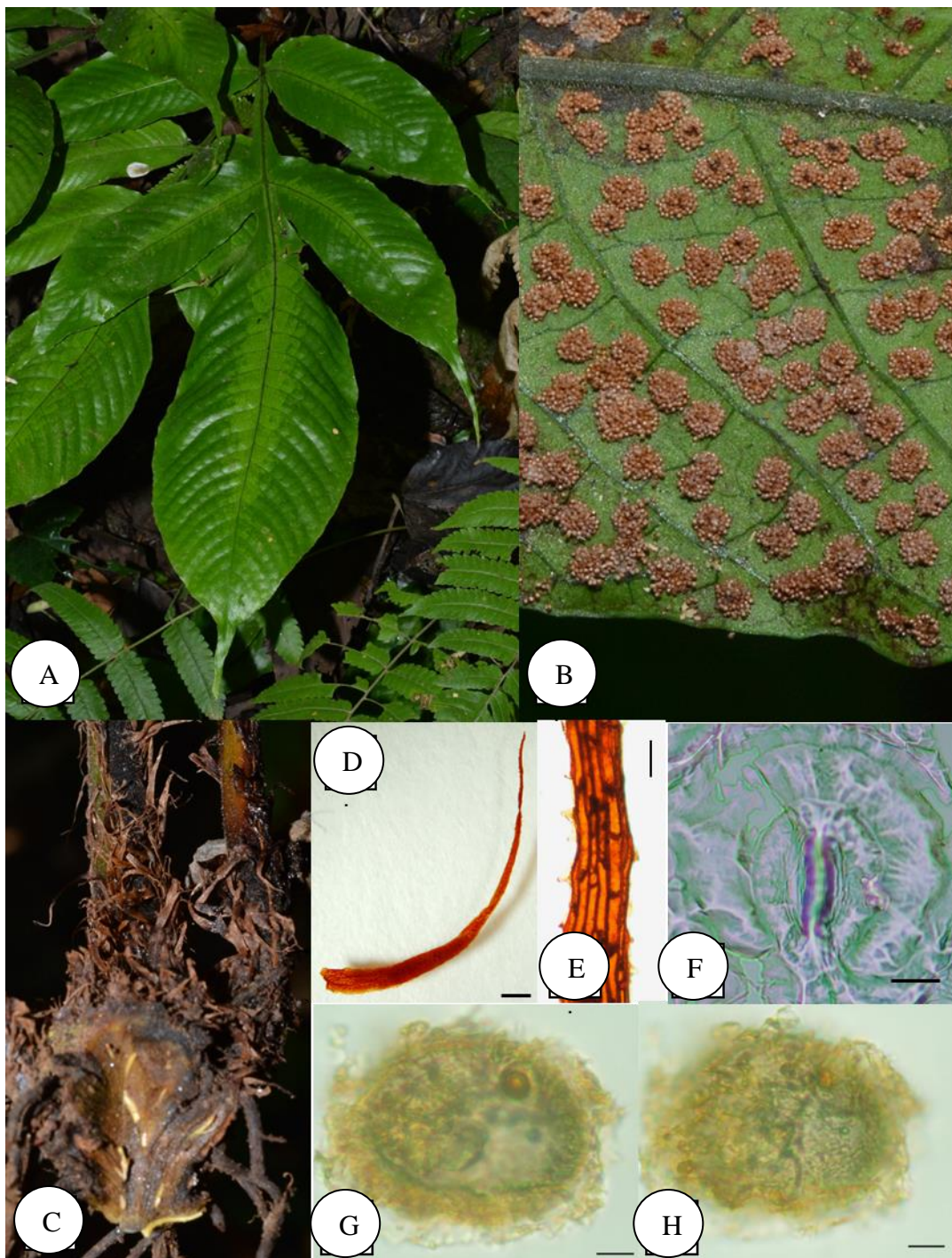


Fig. 4.11 *Tectaria fauriei*

A. natural habitat from Chiang Dao Wildlife Sanctuary, Chiang Mai district; B. sori; C. rhizome; D. scale; E. scale margin; F. stoma; G. spore (optical section); and H. spore (ornamentation) [A.-C. from *P. Prommanut & P. Inthachub* P.387 (BK), D.-H. from *P. Ratchata* 255 (BCU); bar = 1 mm in D., 100  $\mu$ m in E., 10  $\mu$ m in F., and 5  $\mu$ m in G. & H.].



Fig. 4.12 *Tectaria fissa*

A. habit; B. sori; and C. scale [photos were taken from *D.J. Middleton, M. Phuphat, R. Pooma & K. Williams 2951 (BKF)*; bar = 1 mm in C.].



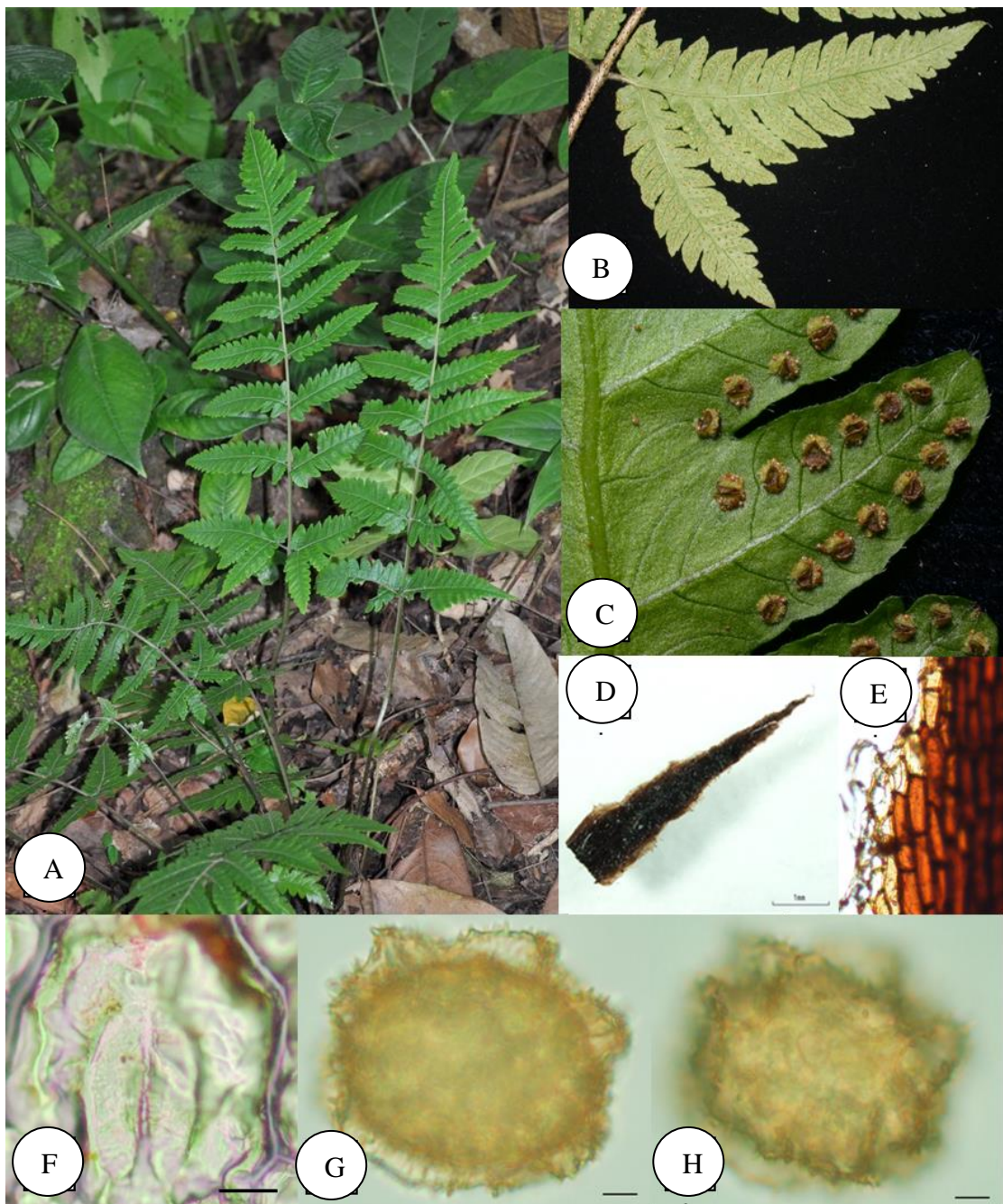


Fig. 4.13 *Tectaria fuscipes*

A. natural habitat from Nong Hin district, Loei province; B. basal pinna; C. venation pattern and sori; D. scale; E. scale margin; F. stoma; G. spore (optical section); and H. spore (ornamentation) [bar = 1 mm in D., 100  $\mu$ m in E., 10  $\mu$ m in F., and 5  $\mu$ m in G. & H.].



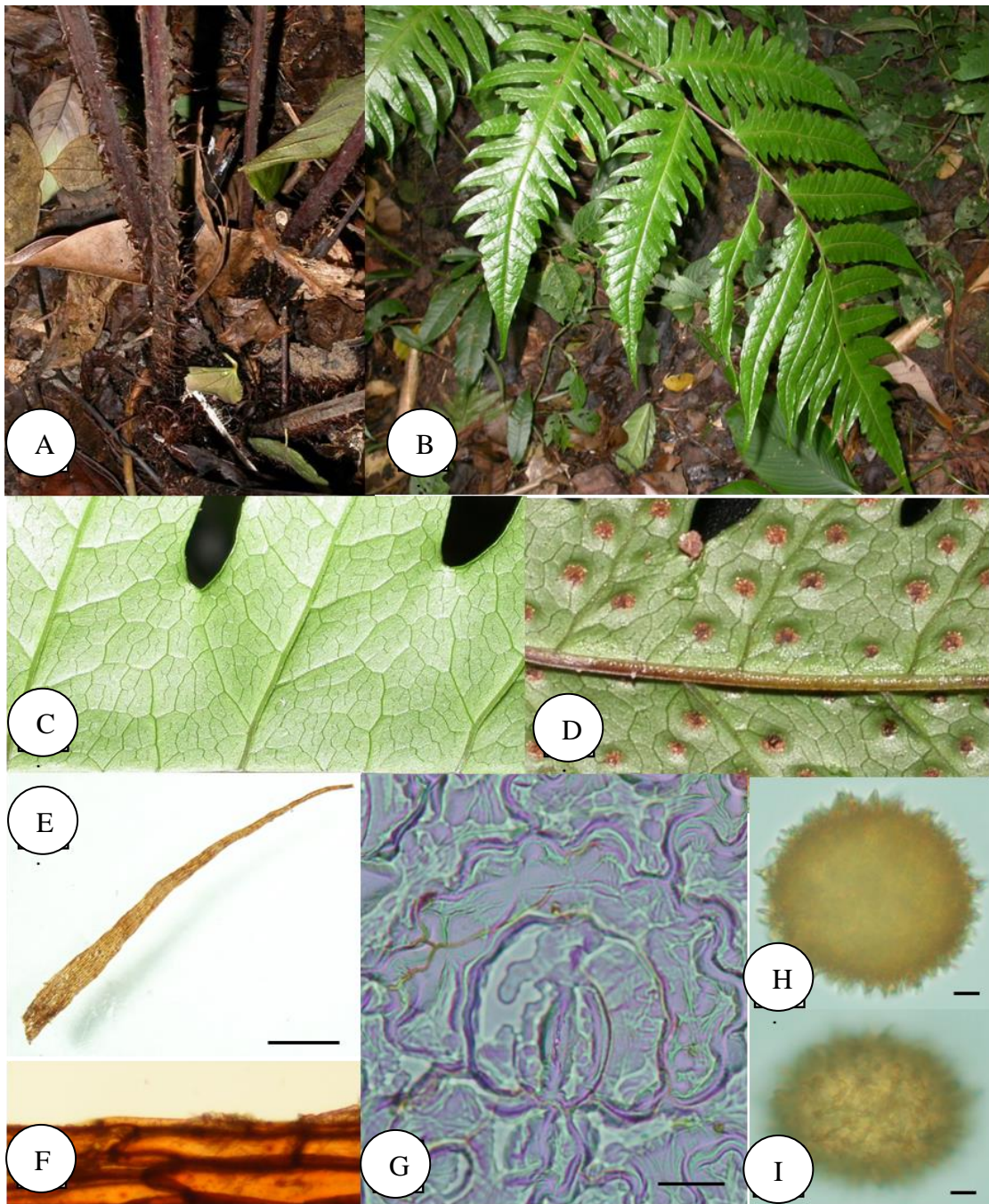


Fig. 4.14 *Tectaria griffithii*

A. rhizome, natural habitat from Suan Phueng district, Ratchaburi province; B. part of a frond; C. venation pattern; D. sori; E. scale; F. scale margin; G. stoma; H. spore (optical section); and I. spore (ornamentation) [bar = 1 mm in E., 100  $\mu$ m in F., 10  $\mu$ m in G., 5  $\mu$ m in H. & I.].



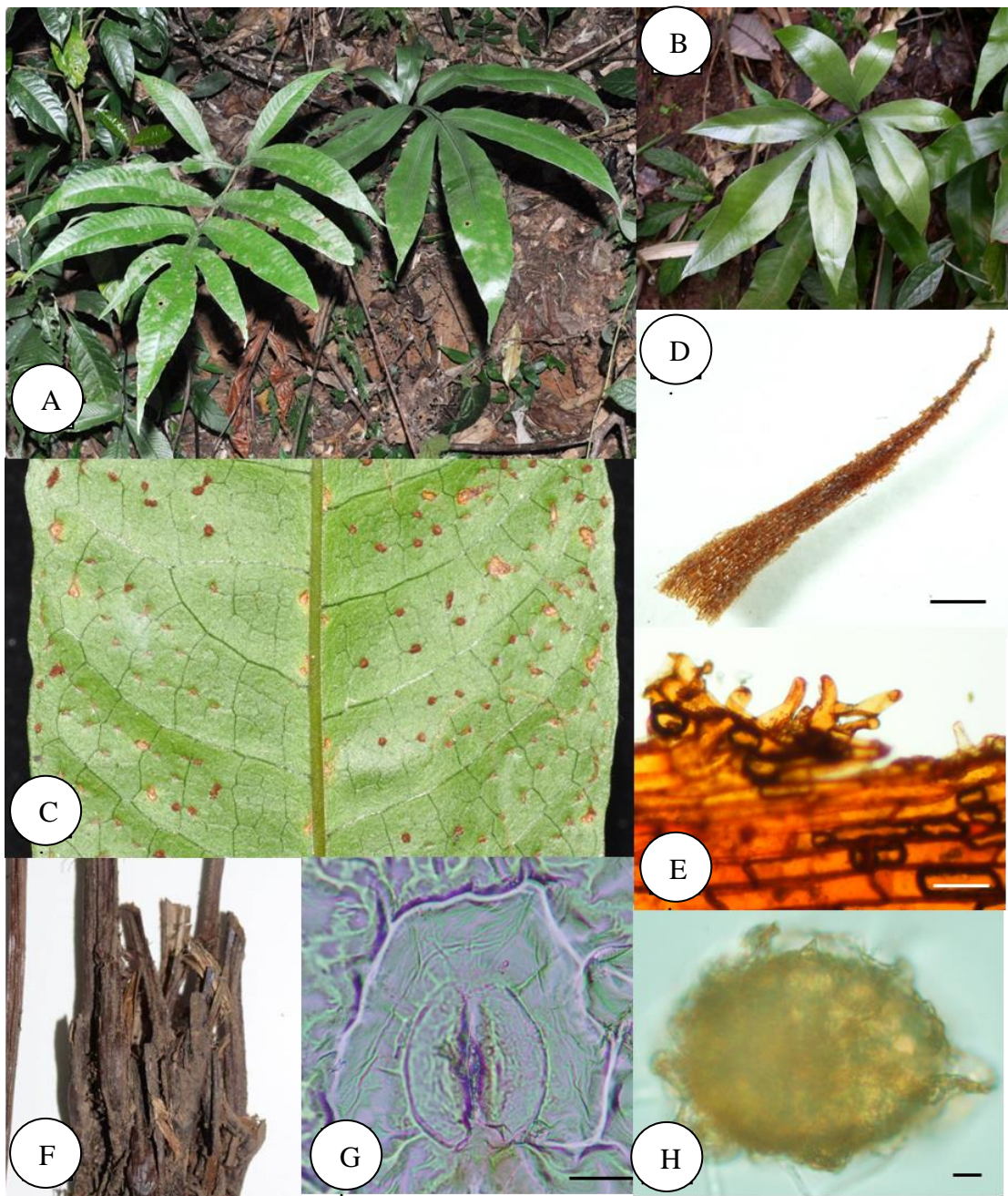


Fig. 4.15 *Tectaria gymnosora*

A. natural habitat from Khao Kho district, Phetchabun province; B. young frond; C. venation and sori; D. scale; E. scale margin; F. rhizome; G. stoma; and H. spore [bar = 1 mm in D., 100 µm in E., 20 µm in G., and 5 µm in H.].



Fig. 4.16 *Tectaria hennipmanii*  
 fertile and sterile fronds, photo was taken from holotype, E. Hennipman 3060 (L).



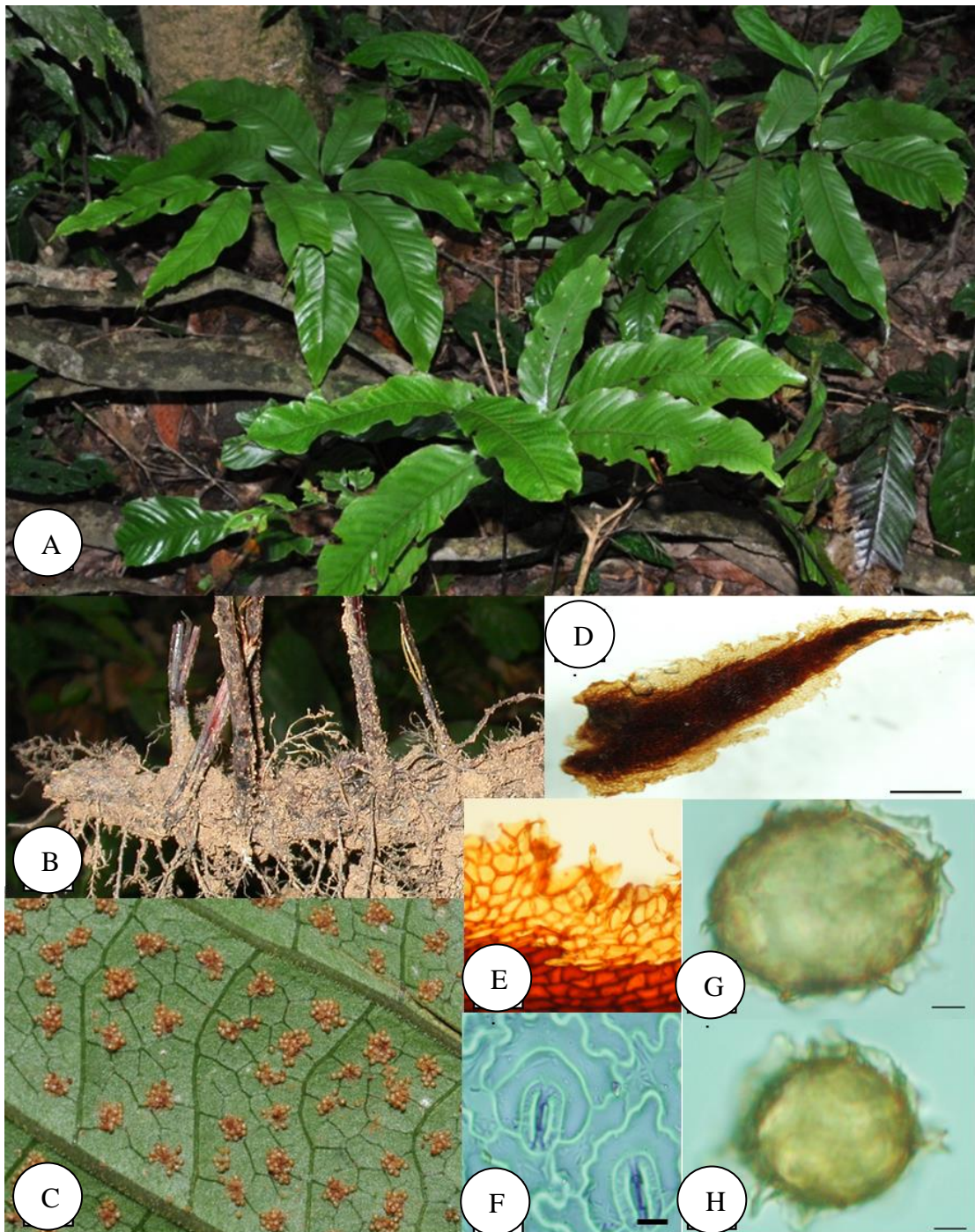


Fig. 4.17 *Tectaria herpetocaulos*

A. natural habitat from Huai Yang Waterfall National Park, Prachuap Khiri Khan province; B. rhizome; C. venation pattern and sori; D. scale; E. scale margin; F. stomata; G. spore (optical section); and H. spore (ornamentation); photos were taken from *Sirisak W. 060* (BCU); bar = 500  $\mu\text{m}$  in D., 20  $\mu\text{m}$  in F., and 5  $\mu\text{m}$  in G. & H.].



Fig. 4.18 *Tectaria hymenophylla*  
habit, photo was taken from *K. Larsen* 10459 (BKF), only once collection from  
Thung Kang Yang Hills, Kanchanaburi province.



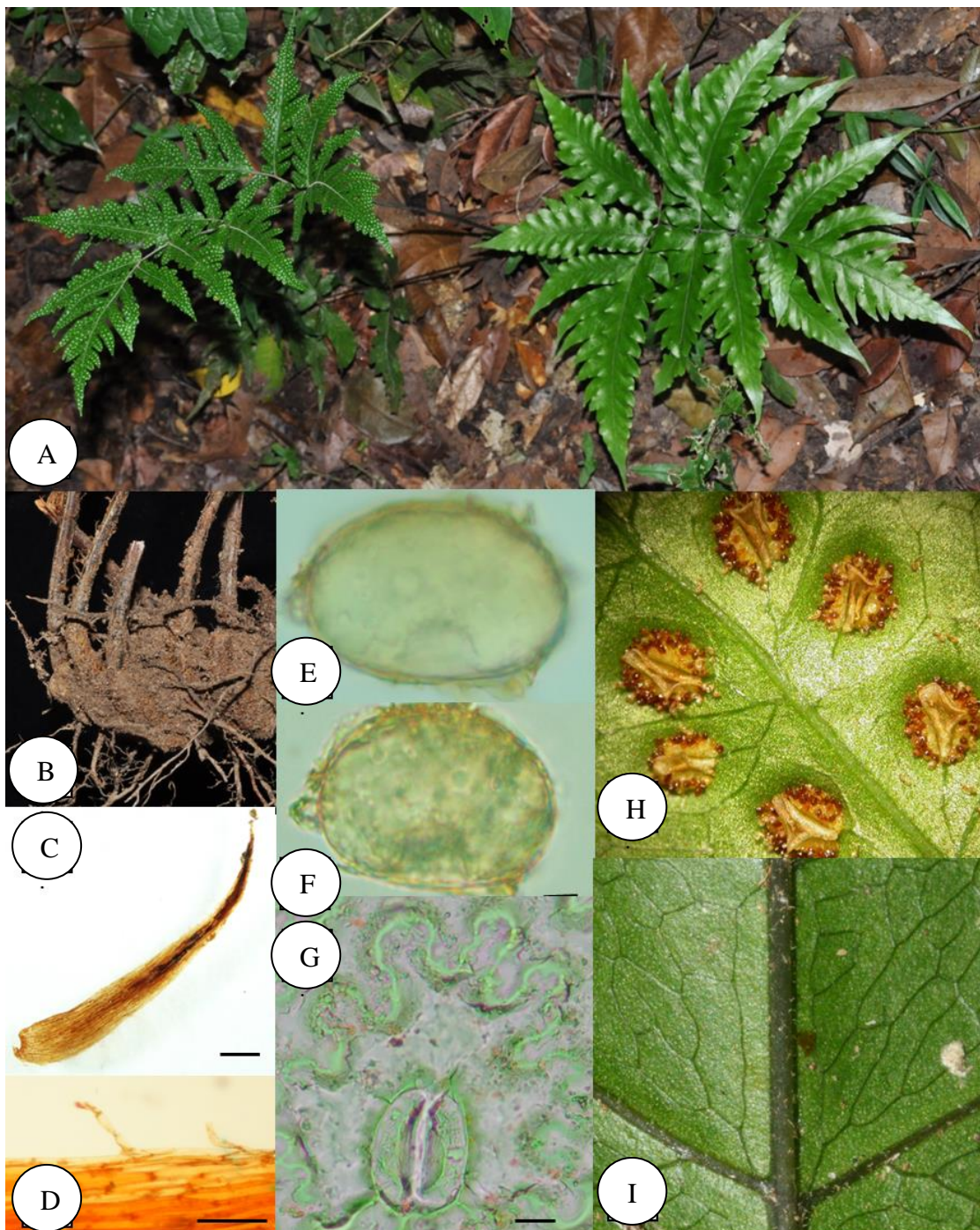


Fig. 4.19 *Tectaria impressa*

A. natural habitat from Huai Yang Waterfall National Park, Prachuap Khiri Khan province; B. rhizome; C. scale; D. scale margin; E. spore (optical section); F. spore (ornamentation); G. stoma; H. sori; and I. costal areoles without free included veinlets [bar = 1 mm in C., 100  $\mu$ m in D., 5  $\mu$ m in E. & F., and 10  $\mu$ m in G.].

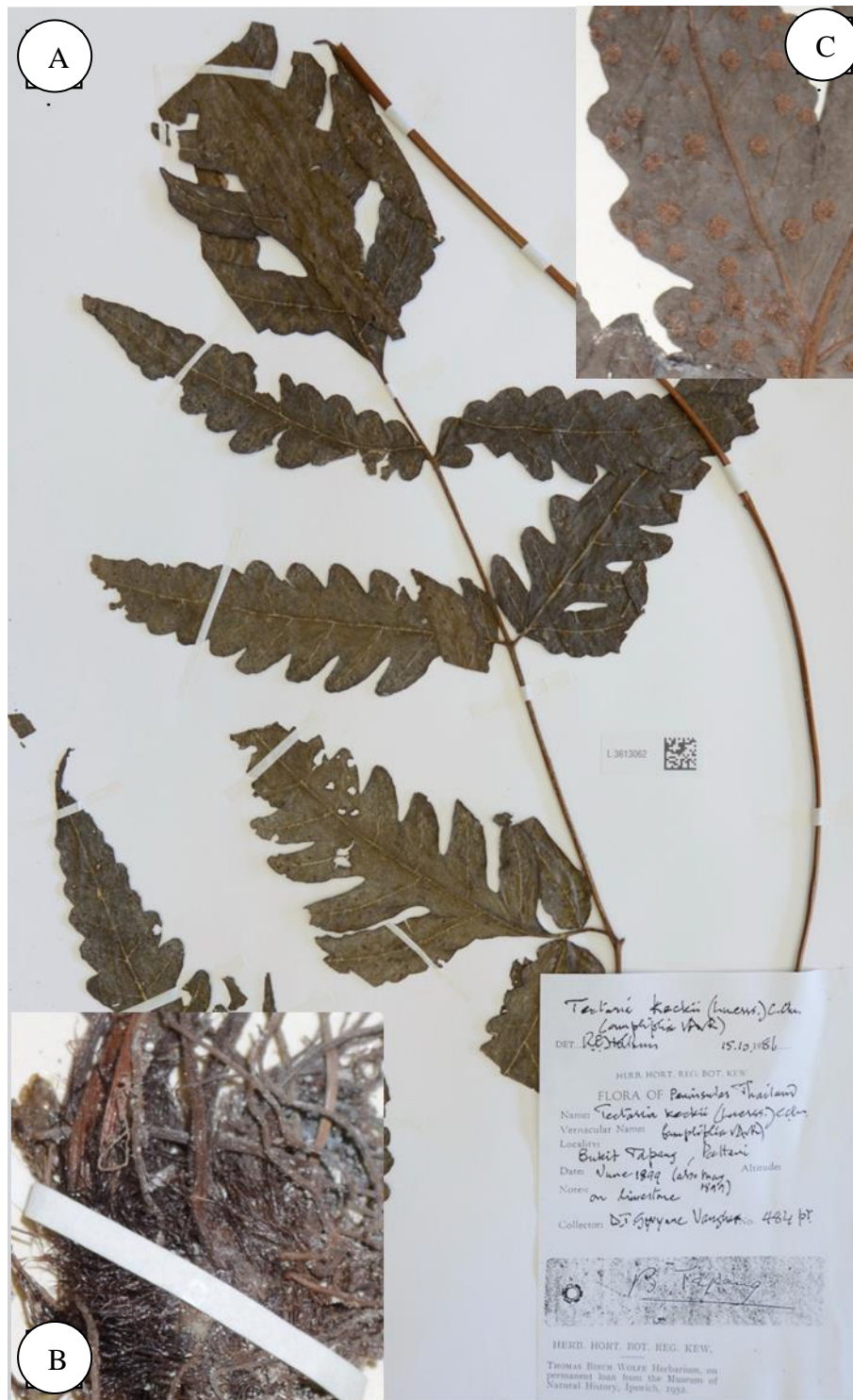


Fig. 4.20 *Tectaria keckii*

A. sterile frond; B. rhizome; C. sori [photos were taken from *D.J.G. Vaughan* 484pr (L)].



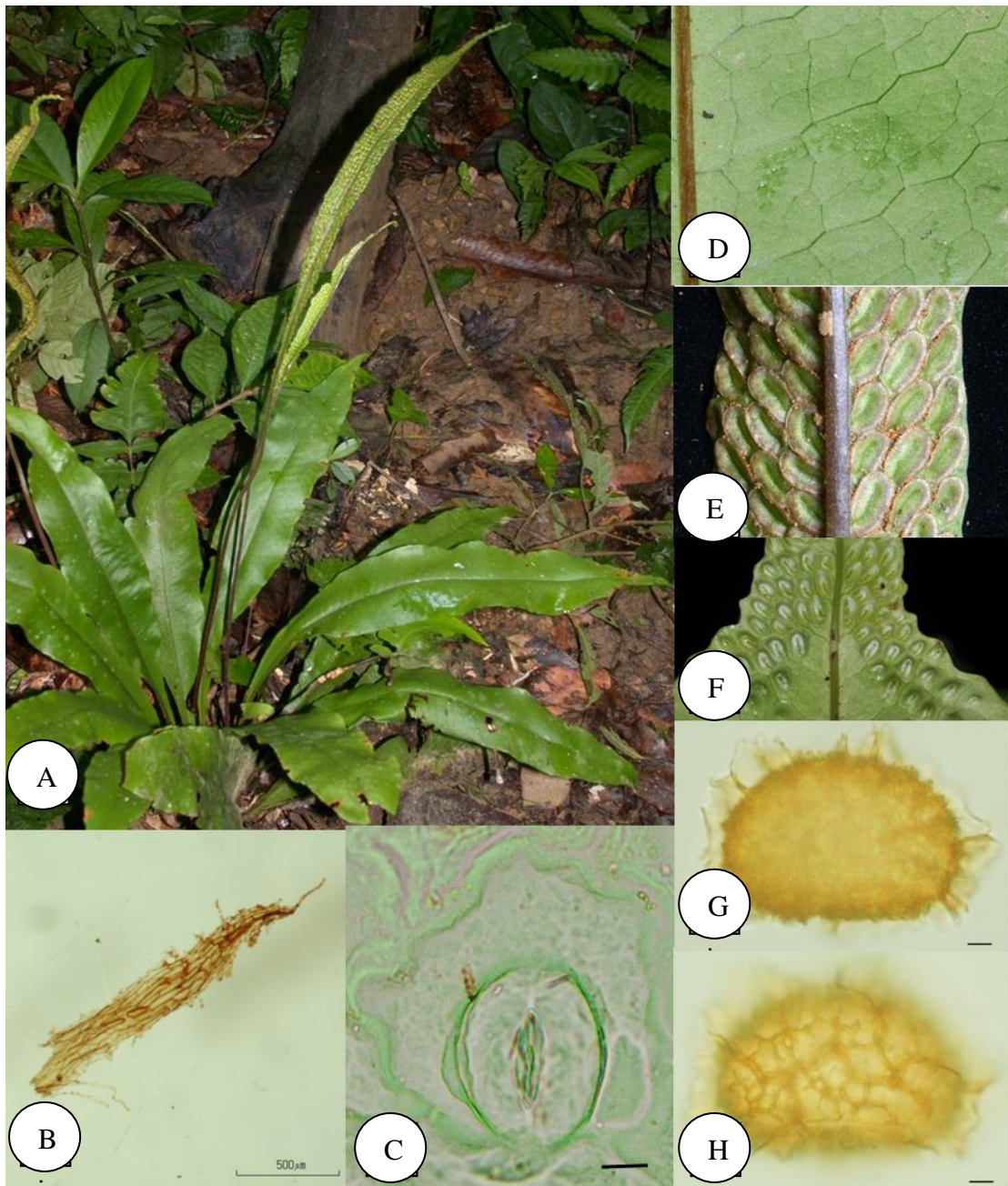


Fig. 4.21 *Tectaria kehdingiana*

A. habit, natural habitat from Khao Luang National Park, Nakhon Si Thammarat province; B. scale; C. stoma; D. venation pattern; E. sori; F. abnormally monomorphic frond with sori at apex; G. spore (optical section); and H. spore (ornamentation) [bar = 500 µm in B., 10 µm in C., and 5 µm in G. & H.].

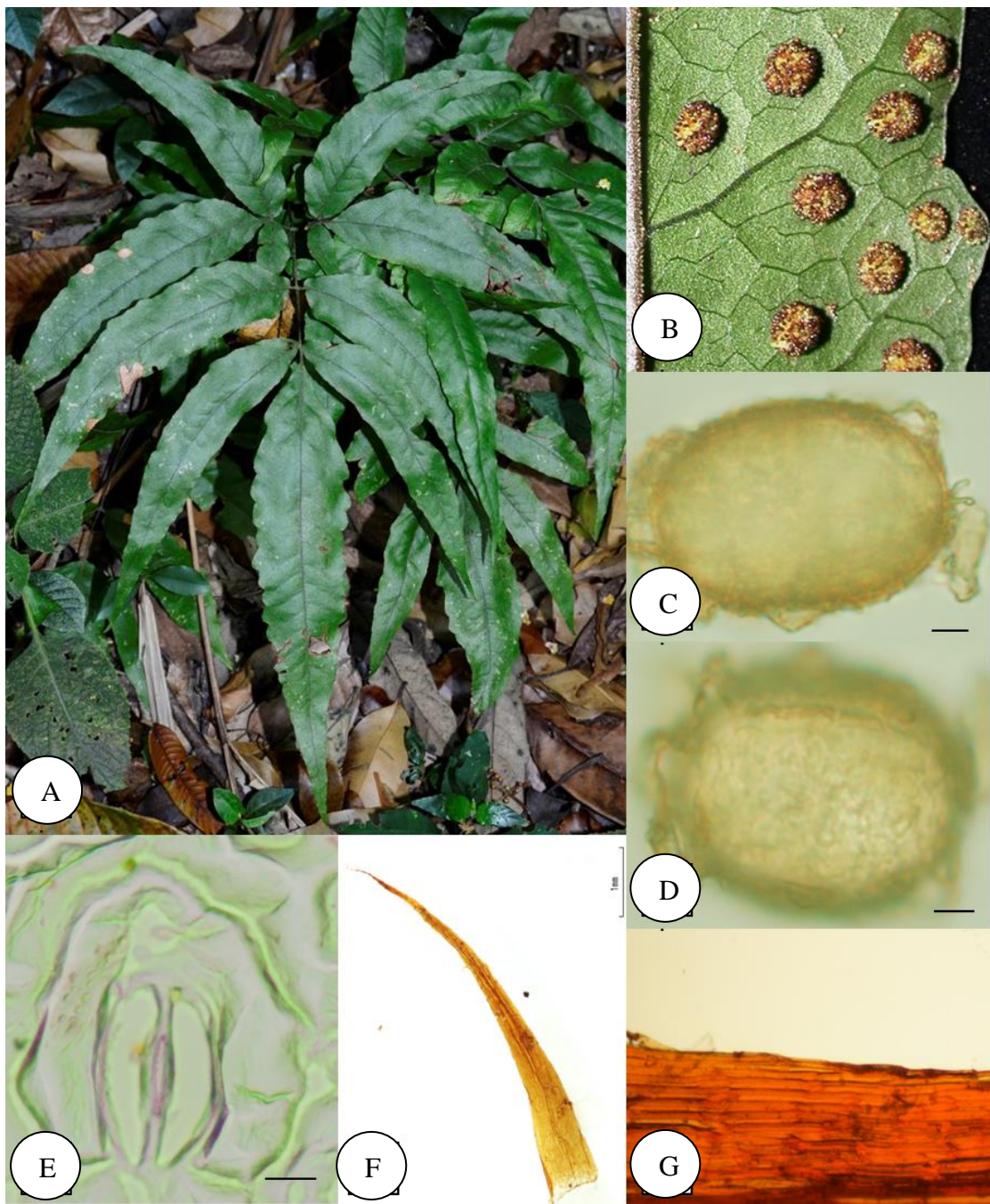


Fig. 4.22 *Tectaria laotica*

A. natural habitat from Phu Suan Sai National Park, Loei province; B. venation pattern and sori; C. spore (optical section); D. spore (ornamentation); E. stoma; F. scale; and G. scale margin [bar = 5  $\mu\text{m}$  in C. & D., 10  $\mu\text{m}$  in E., and 1 mm in F.].



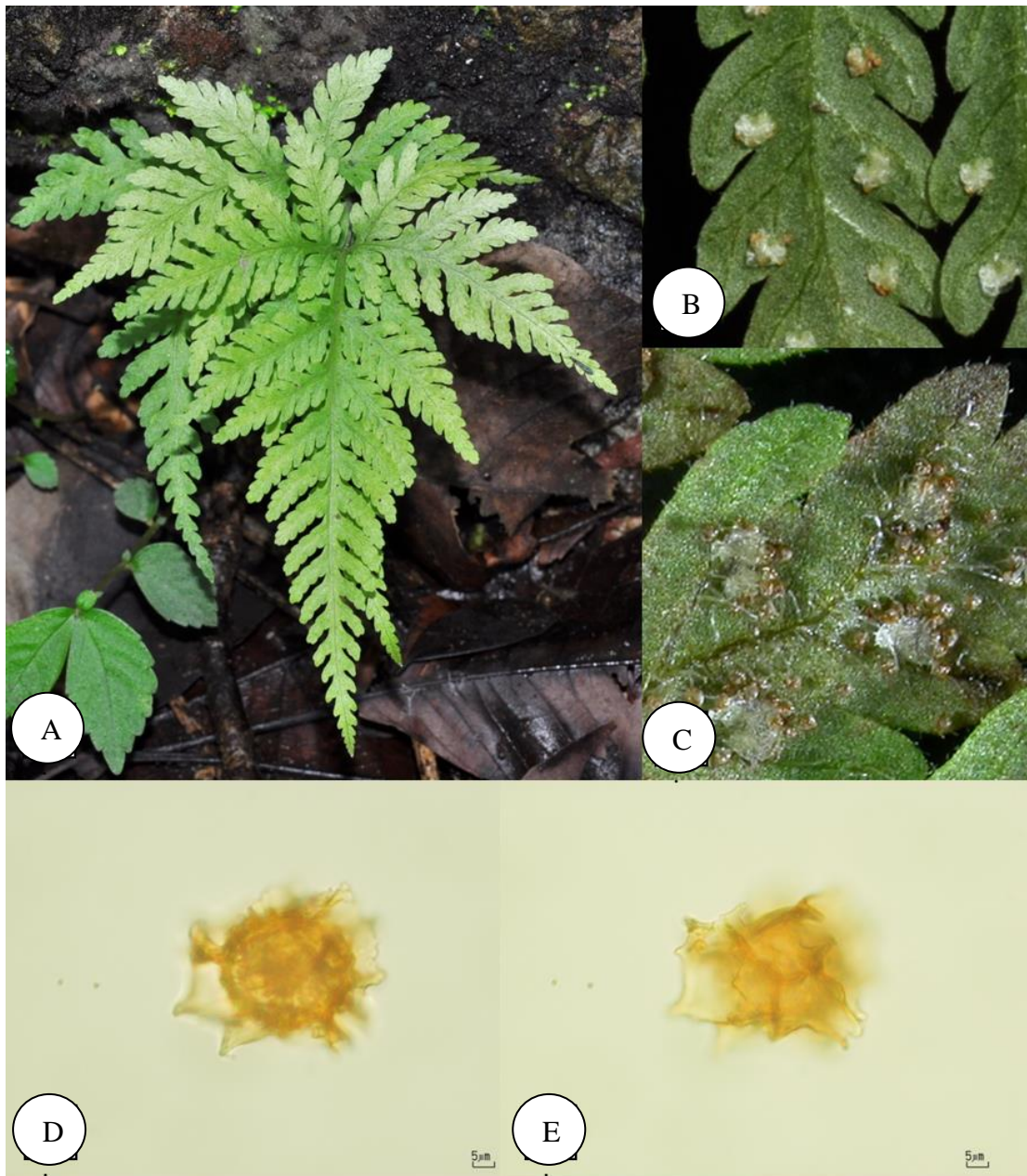


Fig. 4.23 *Tectaria manilensis*

A. natural habitat from Tha Song Yang district, Tak province; B. young sori; C. sori and indusia; D. spore (optical section); and E. spore (ornamentation) [bar = 5 µm in D. & E.].

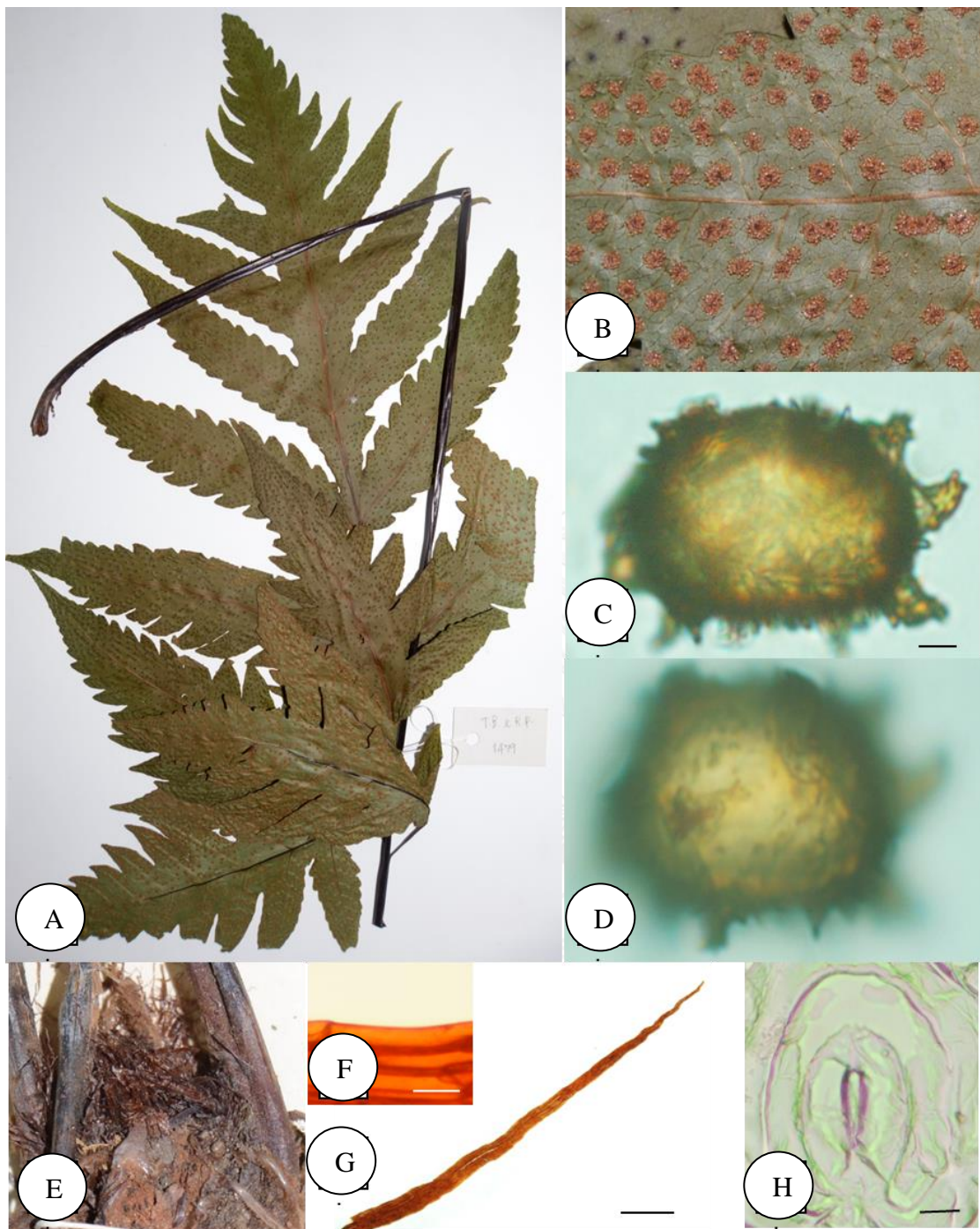


Fig. 4.24 *Tectaria melanocaula*

A. part of a fertile frond; B. venation pattern and sori; C. spore (optical section); D. spore (ornamentation); E. rhizome with scales at apex; F. scale margin; G. scale; and H. stoma [photos A.-D. & H. were taken from *T. Boonkerd et al.* 2011-566 (BCU), E.-G. from *E. Smith* 1842 (K); bar = 5  $\mu$ m in C. & D., 50  $\mu$ m in F., 1 mm in G., and 5  $\mu$ m in H.].



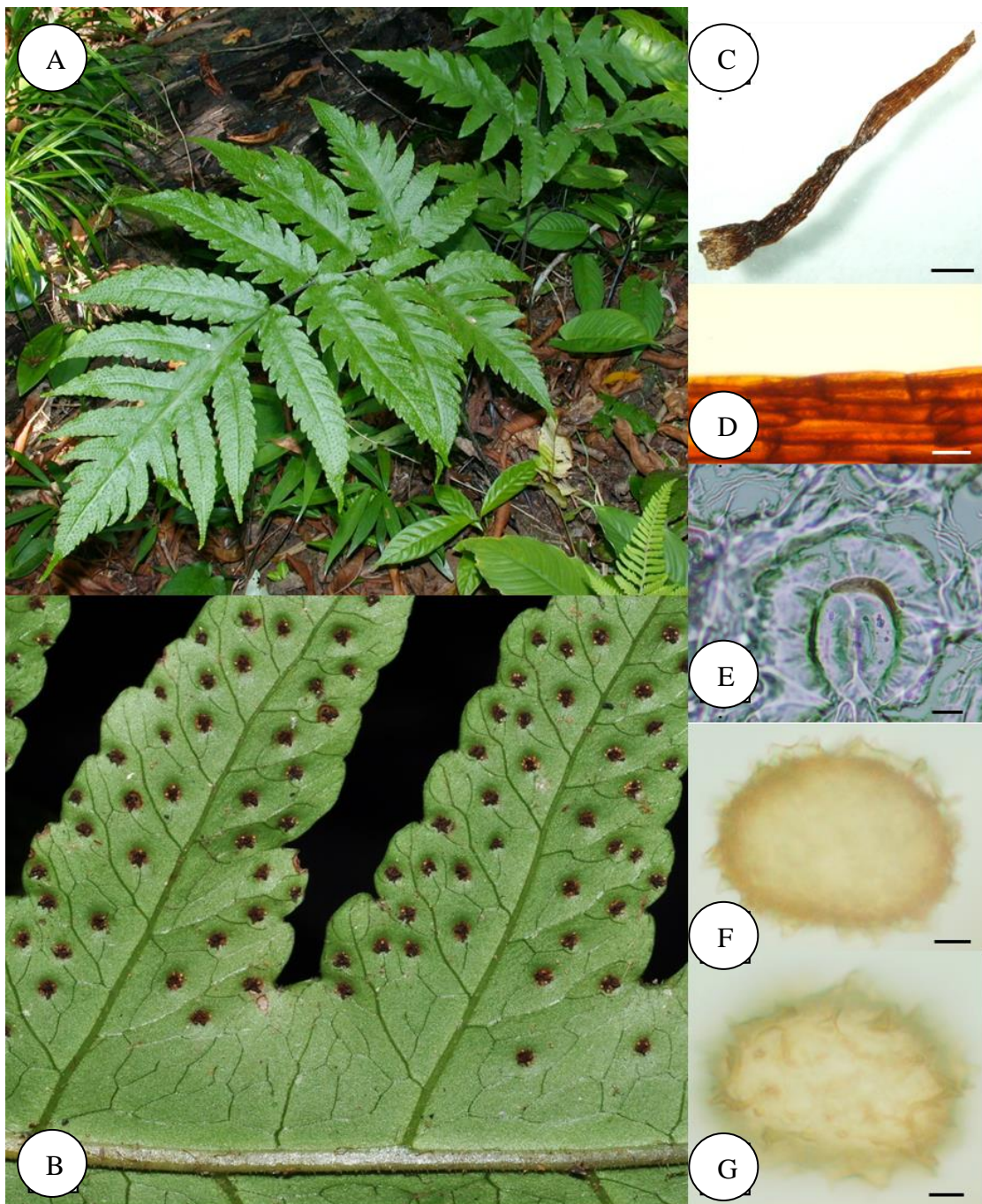


Fig. 4.25 *Tectaria multicaudata*

A. habit, natural habitat from Si Khid Waterfall National Park, Nakhon Si Thammarat province; B. venation pattern and sori; C. scale; D. scale margin; E. stoma; F. spore (optical section); and G. spore (ornamentation) [bar = 1 mm in C., 50  $\mu$ m in D., 10  $\mu$ m in E. and 5  $\mu$ m in F. & G.].



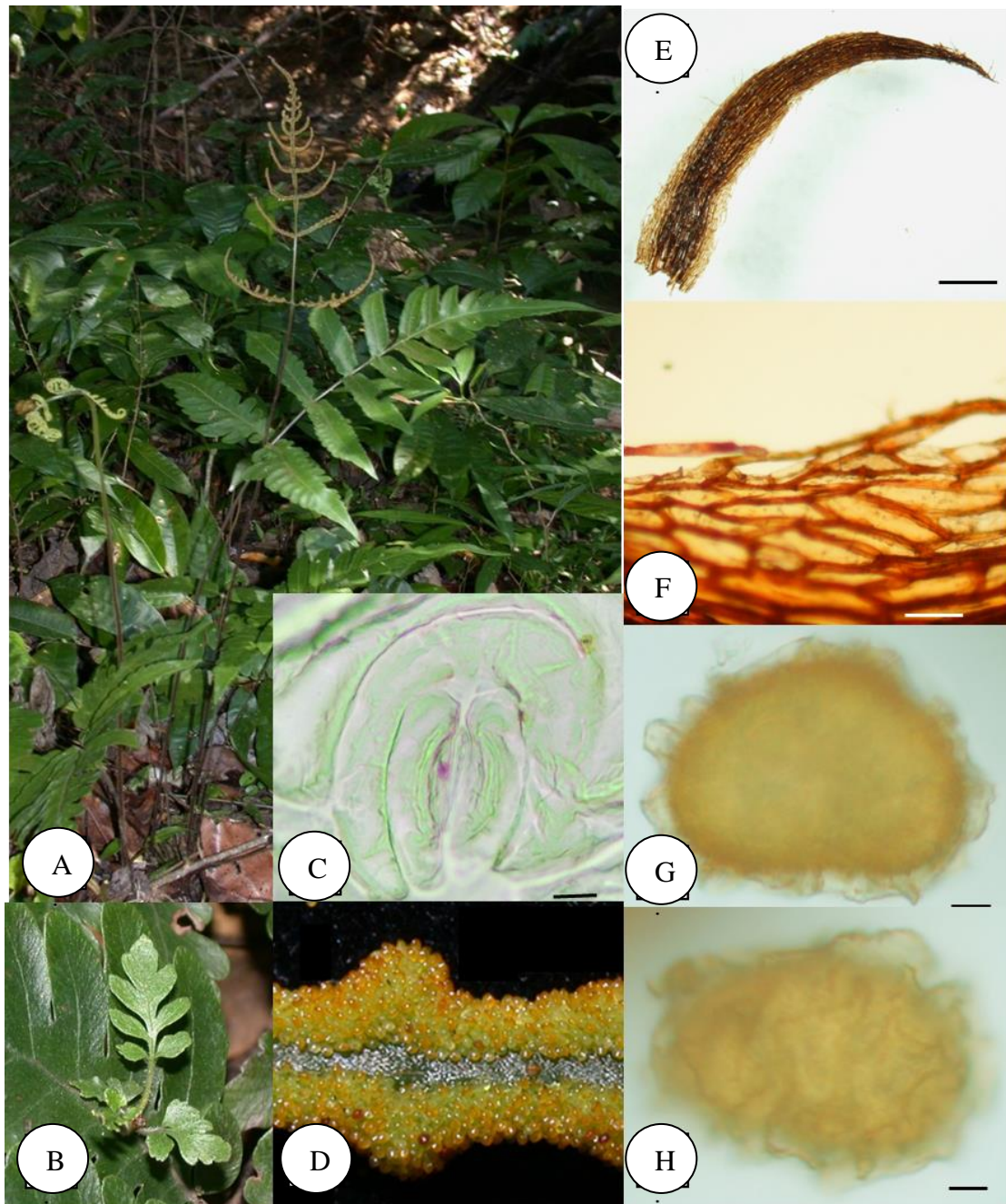


Fig. 4.26 *Tectaria nayarii*

A. habit, natural habitat from Si Khid Waterfall National Park, Nakhon Si Thammarat province; B. proloferous bulbil; C. stoma; D. sori; E. scale; F. scale margin; G. spore (optical section); and H. spore (ornamentation) [bar = 10  $\mu$ m in C., 1 mm in E., 100  $\mu$ m in F., and 5  $\mu$ m in G. & H.].

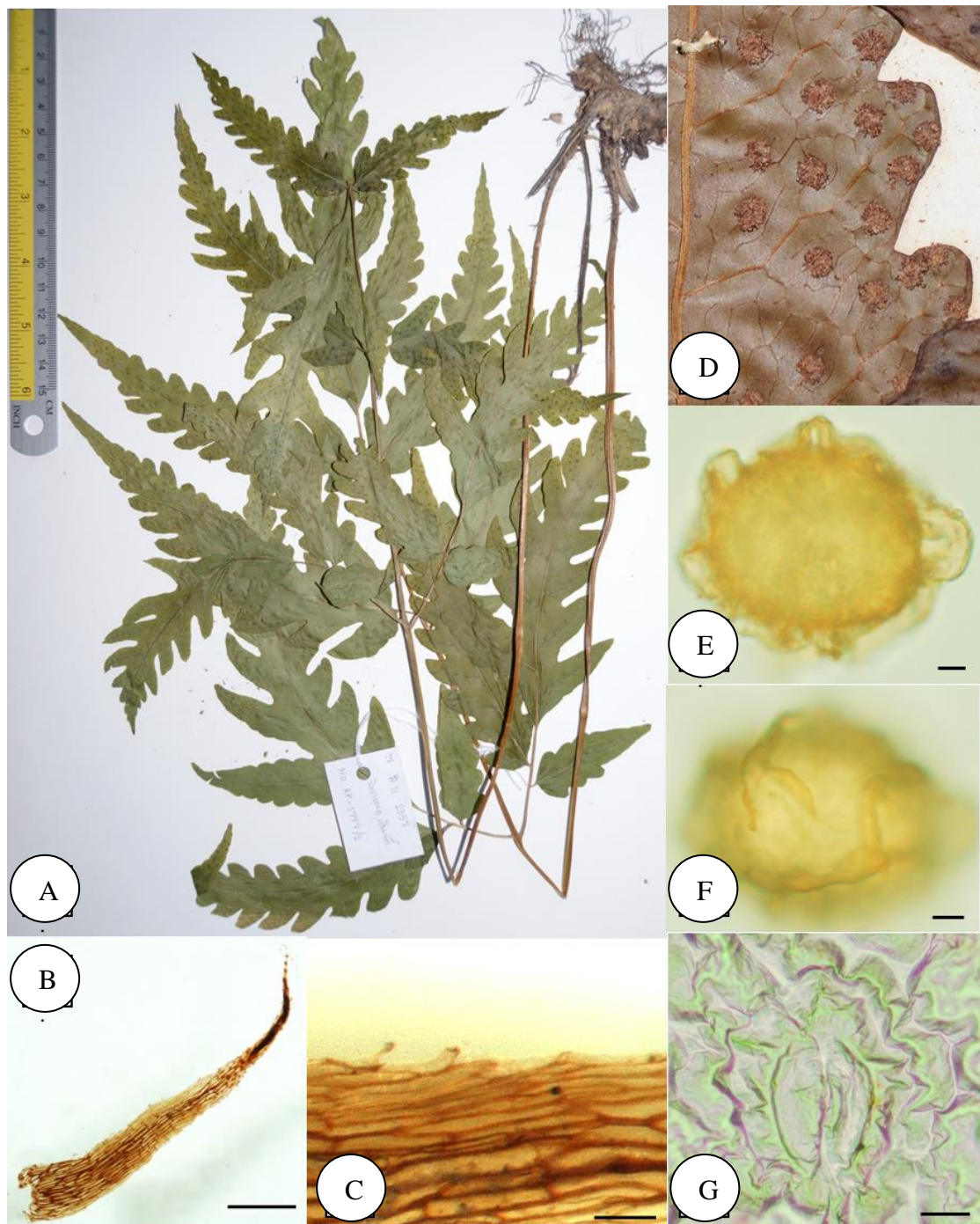


Fig. 4.27 *Tectaria phaeocaulis*

A. habit; B. scale; C. scale margin; D. venation pattern and sori; E. spore (optical section); F. spore (ornamentation); and G. stoma [A.-C. & G. from *R. Pollawatn* 1777 (BCU), D. from *K. Iwatsuki & N. Fukuoka* T-3682 (BKF), E.-F. from *A. Sathapattayanon* 488 (BCU); bar = 1 mm in B., 100  $\mu$ m in C., 5  $\mu$ m in E., F. & G.].



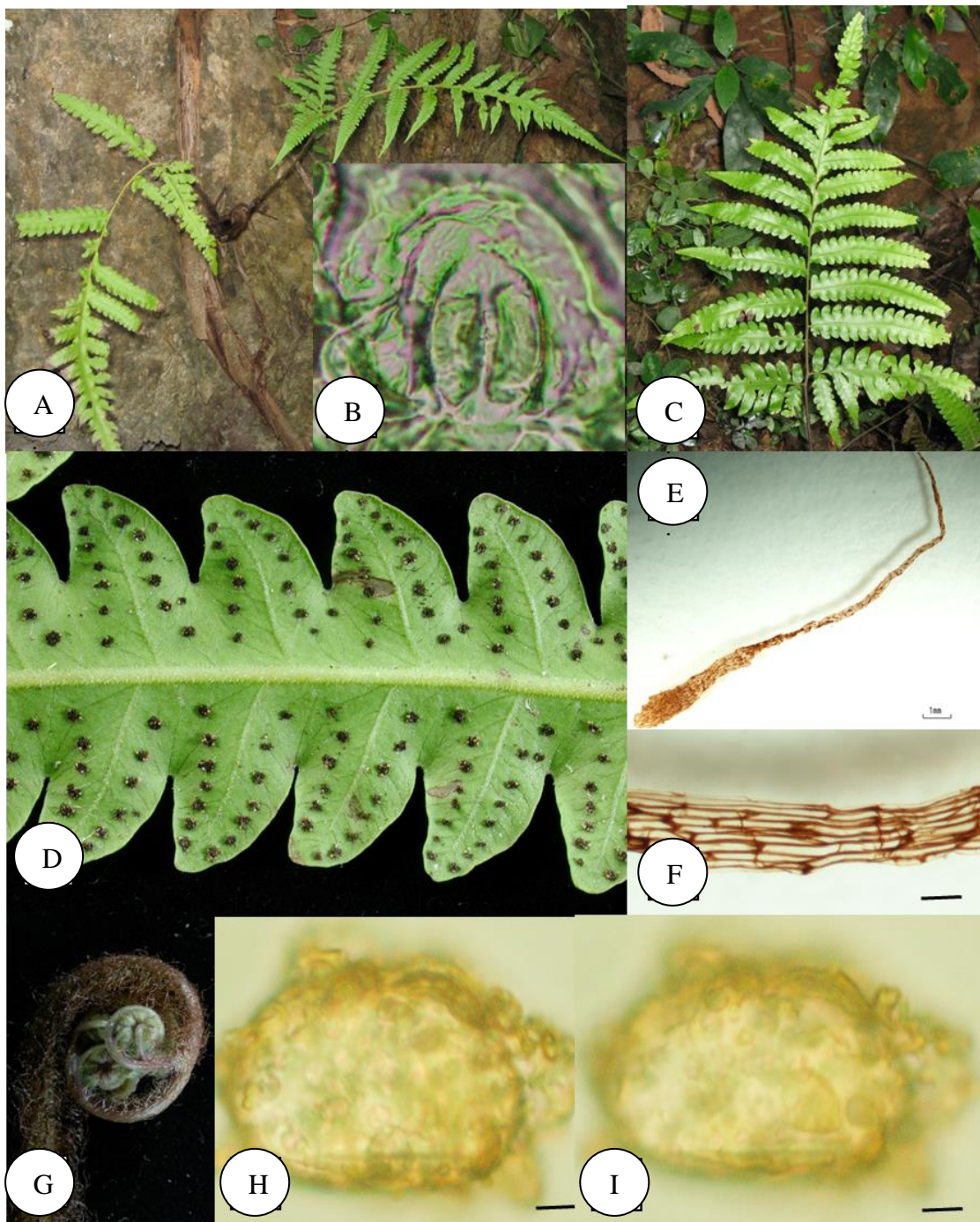


Fig. 4.28 *Tectaria. phanomensis*

A. habit, natural habitat from Si Khid Waterfall National Park, Nakhon Si Thammarat province; B. stoma; C. frond; D. venation pattern and. sori; E. scale; F. scale margin; G. crozier with dense scales; H. spore (optical section); and I. spore (ornamentation) [bar = 10  $\mu$ m in B., 1 mm in E., 100  $\mu$ m in F., and 5  $\mu$ m in H. & I.].

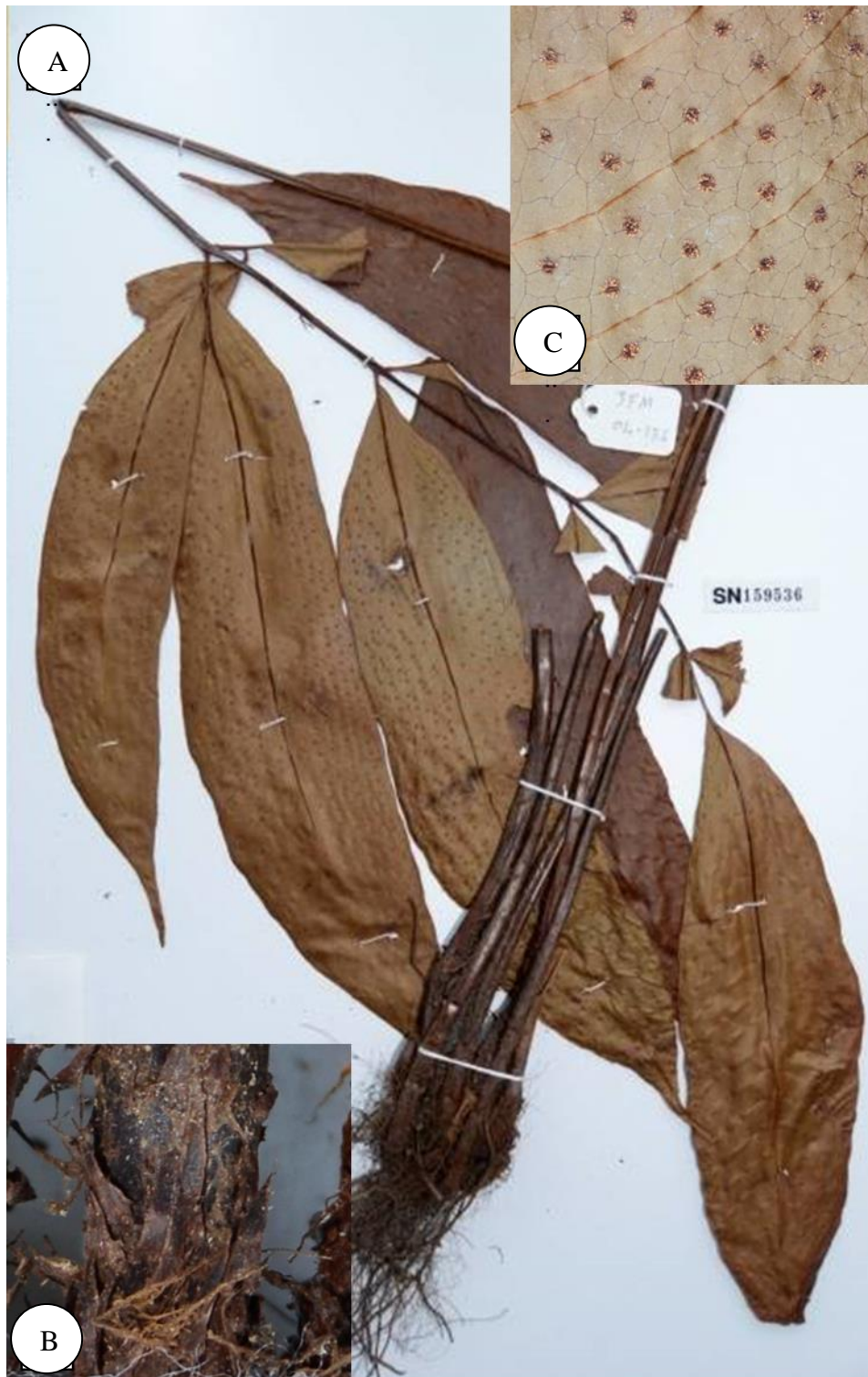


Fig. 4.29 *Tectaria poilanei*

A. habit, B. scales; C. venation pattern and sori [photos were taken from *J.F. Maxwell* 04-156 (BKF)].



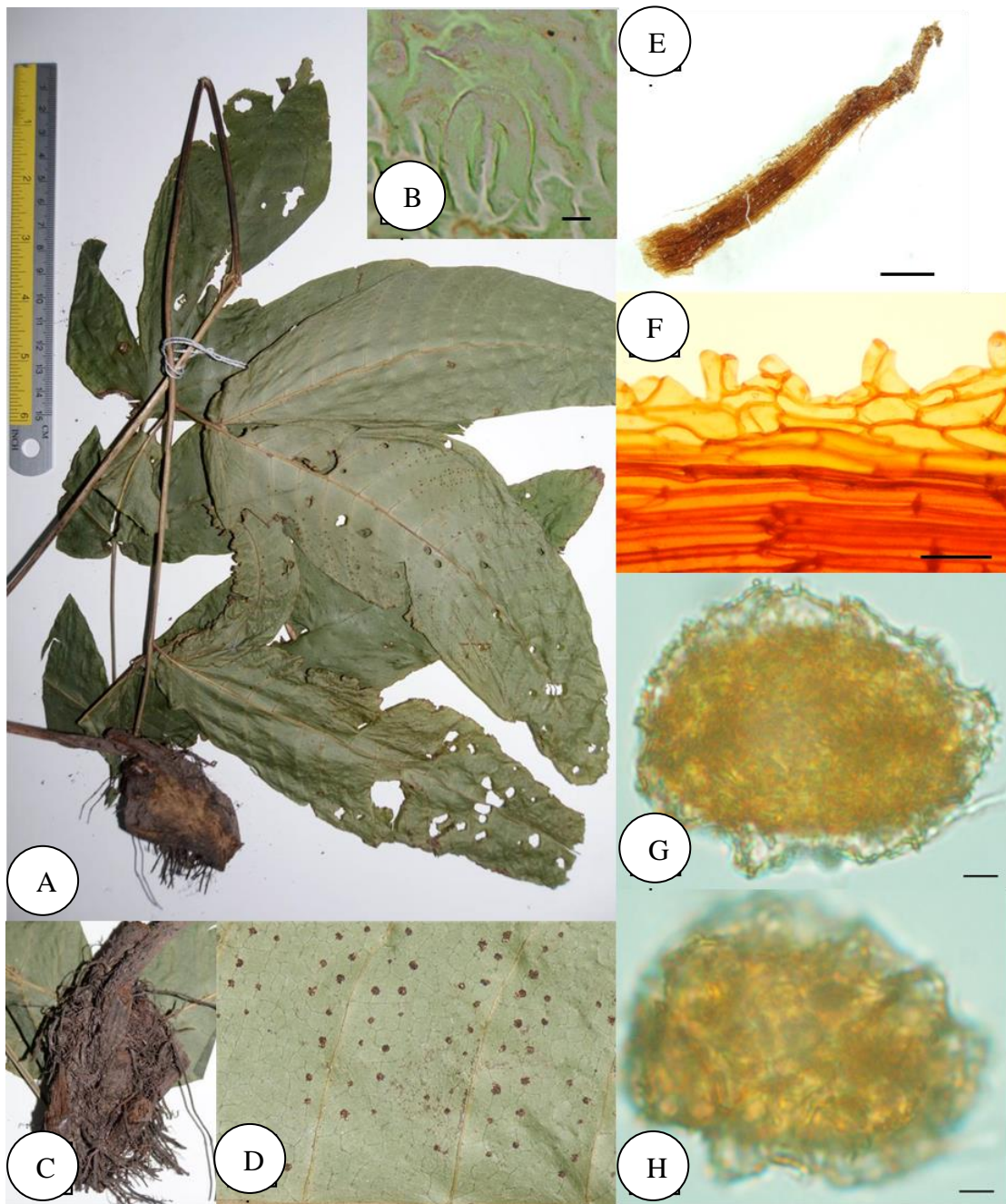


Fig. 4.30 *Tectaria polymorpha*

A. habit, *Sirisak* W. 002 from Phu Hin Rong Kla National Park, Loei province;  
 B. stoma; C. rhizome; D. venation pattern and sori; E. scale; F. scale margin; G.  
 spore (optical section); and H. spore (ornamentation) [bar = 10  $\mu$ m in B., 1 mm in E.,  
 100  $\mu$ m in F., and 5  $\mu$ m in G. & H.].

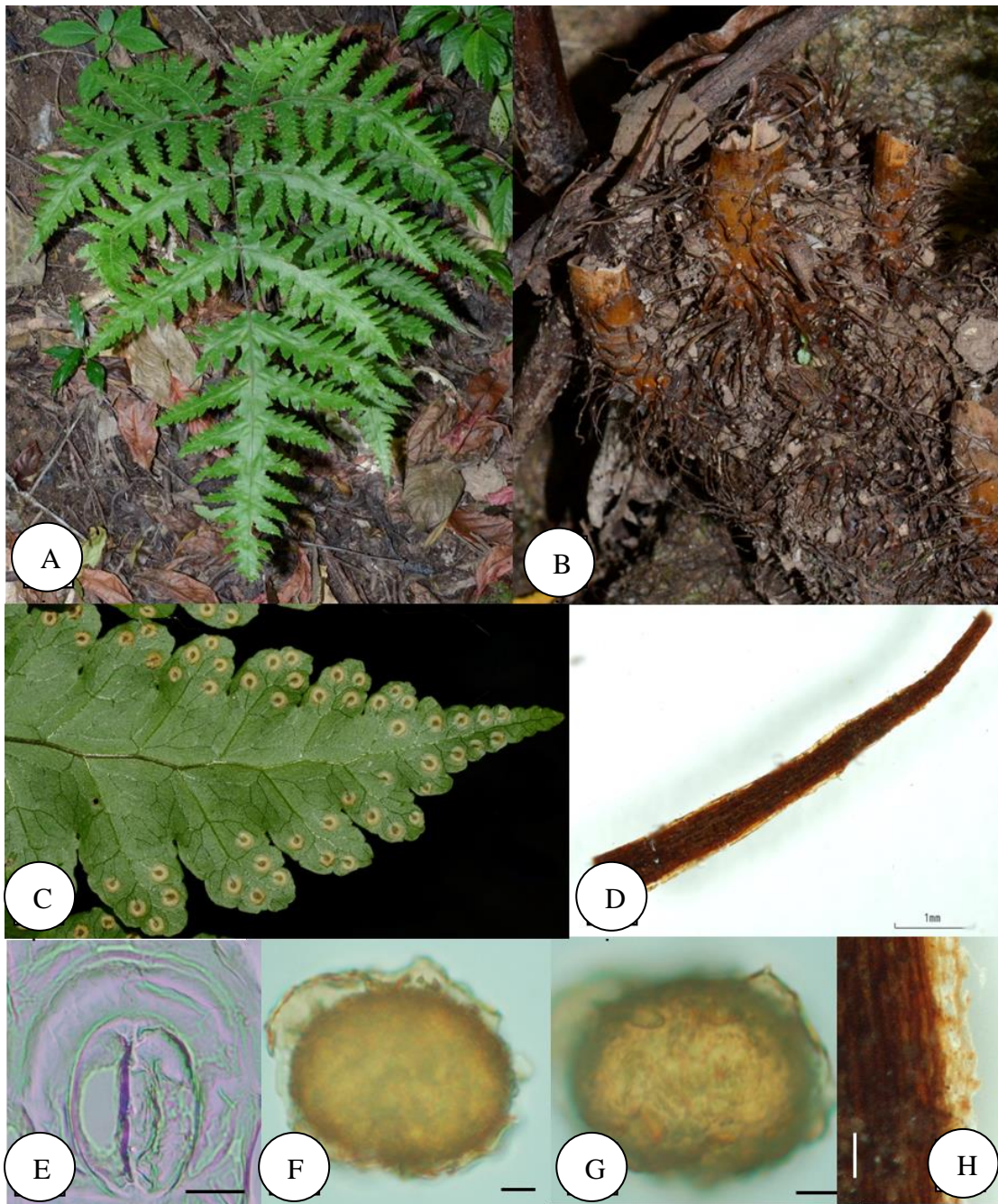


Fig. 4.31 *Tectaria remotipinna*

A. habit, *Sirisak W. 088* from Doi Pha Hom Pok National Park, Chiang Mai province; B. rhizome and stipe base with the rosette of scales; C. venation pattern and sori; D. scale; E. stoma; F. spore (optical section); G. spore (ornamentation); h. scale margin [bar 1 mm in D., = 10 µm in E., 5 µm in F. & G., and 100 µm in h.].



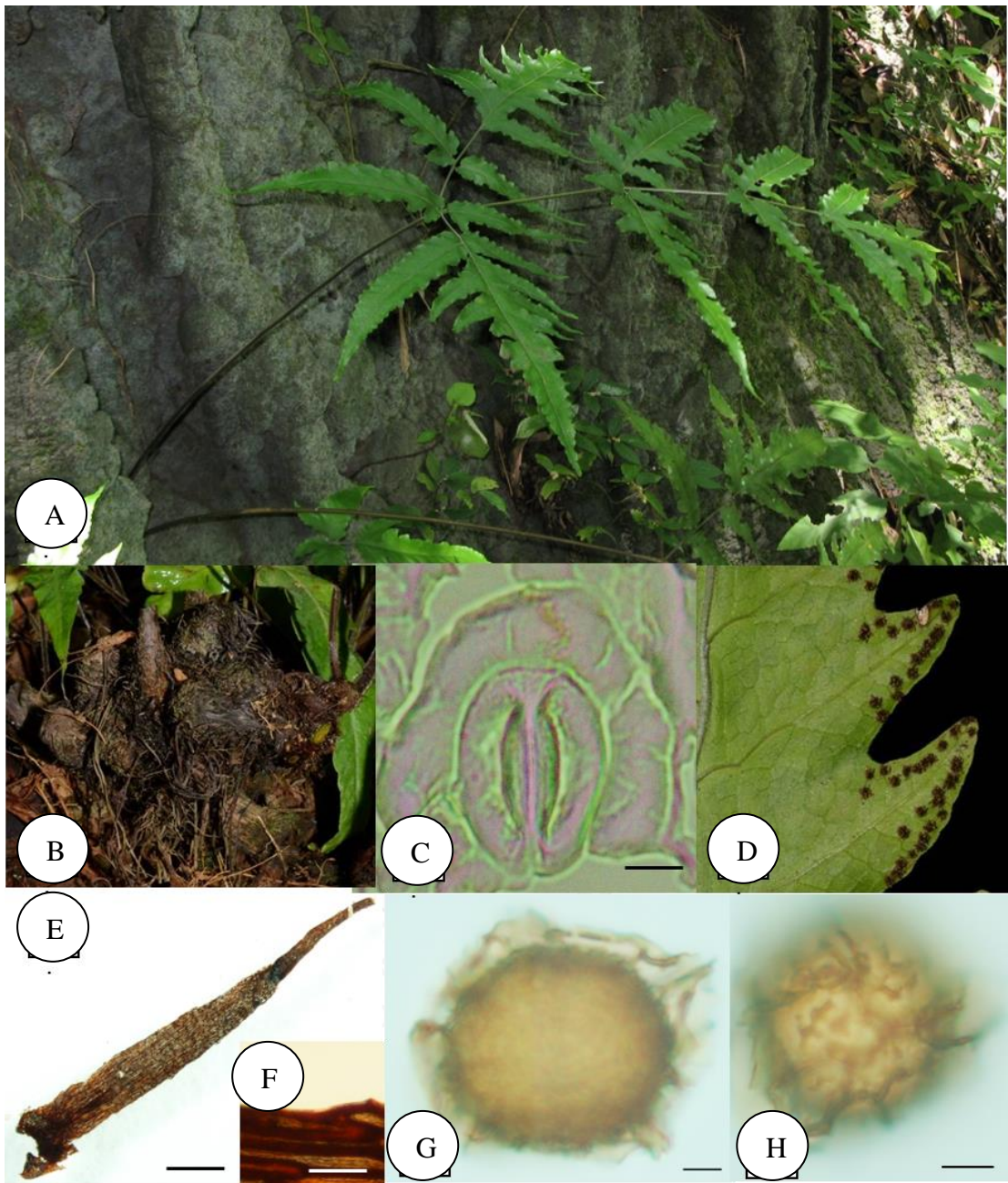


Fig. 4.32 *Tectaria rockii*

A. natural habitat from Tee Lor Su Waterfalls, Tak province; B. rhizome; C. stoma; D. venation pattern and sori; E. scale; F. scale margin; G. spore (optical section); and H. spore (ornamentation); [bar = 10  $\mu$ m in C., 1 mm in E., 100  $\mu$ m in F., and 5  $\mu$ m in G. & H.].

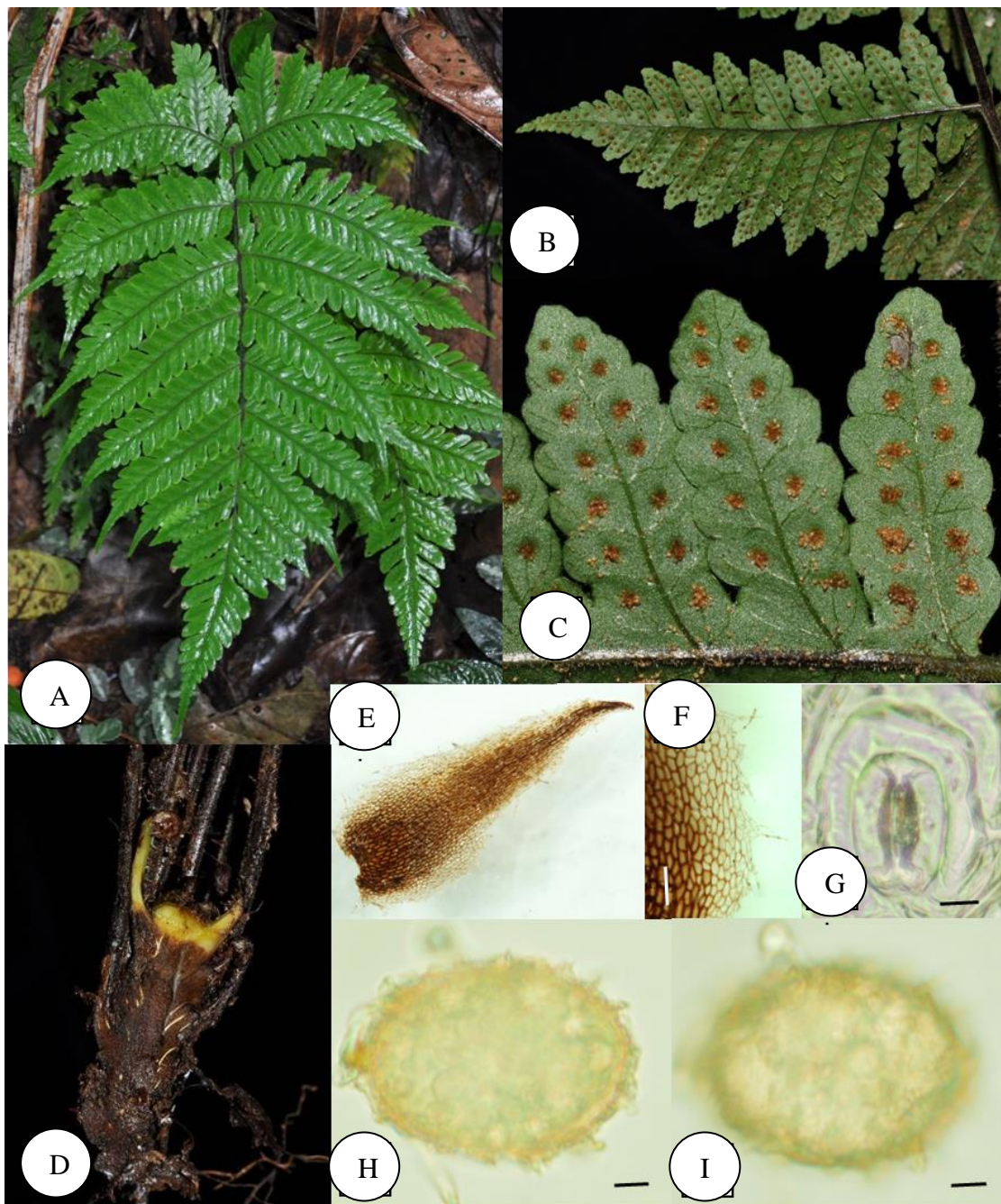


Fig. 4.33 *Tectaria sagenioides*

A. natural habitat from Khao Kho district, Phetchabun province; B. basal pinna; C. venation pattern and sori; D. rhizome; E. scale; F. scale margin; G. stoma; H. spore (optical section); and I. spore (ornamentation); [bar = 1 mm in E., 100  $\mu$ m in F., 10  $\mu$ m in G., and 5  $\mu$ m in H. & I.].



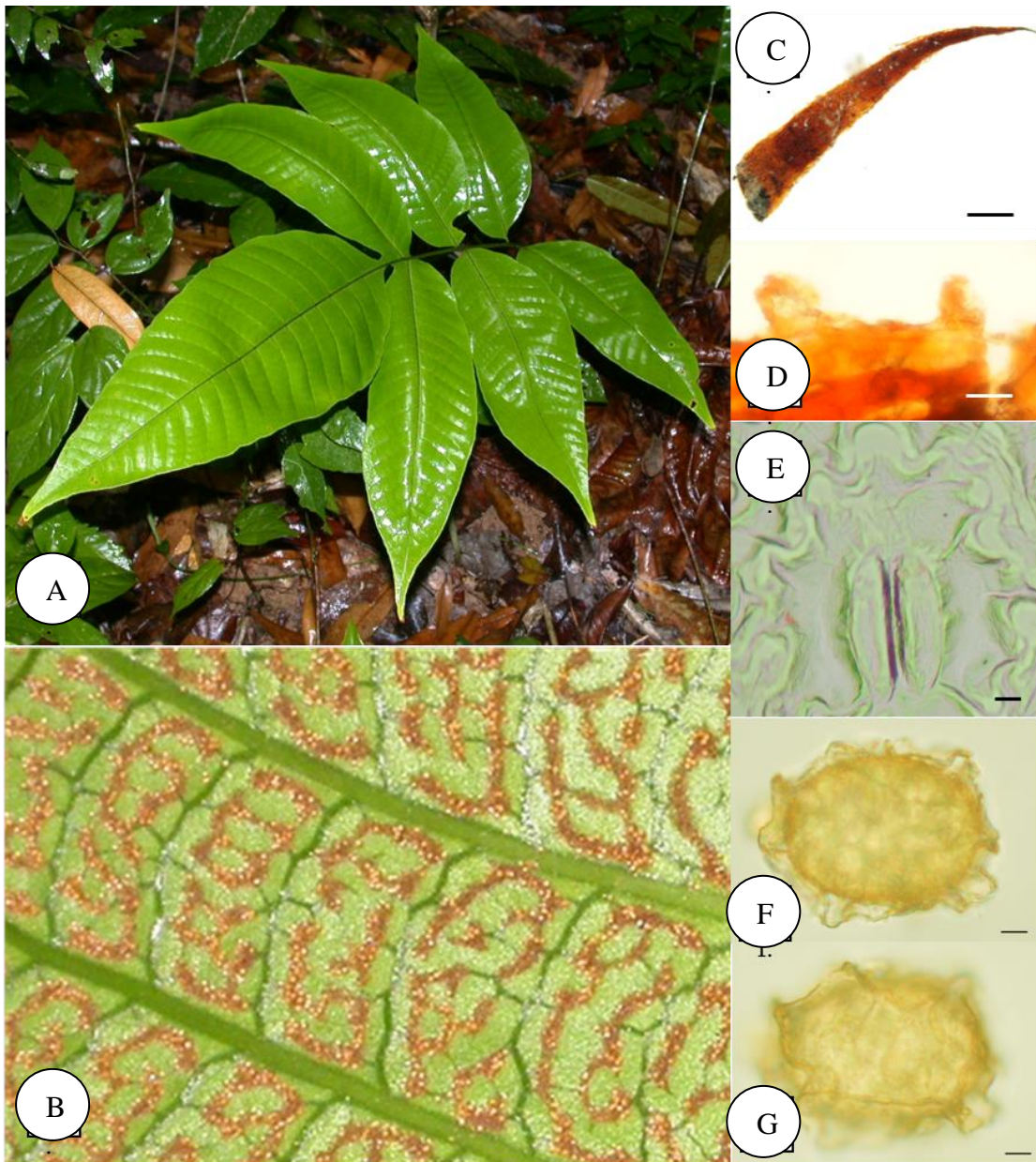


Fig. 4.34 *Tectaria semipinnata*

A. natural habitat from Khao Luang National Park, Nakhon Si Thammarat province; B. venation pattern and sori; C. scale; D. scale margin; E. stoma; F. spore (optical section); and G. spore (ornamentation); [bar = 1 mm in C., 100  $\mu$ m in D., 10  $\mu$ m in E., and 5  $\mu$ m in F. & G.].



Fig. 4.35 *Tectaria siifolia*  
 habit, showing rhizome, scale, sterile frond, fertile frond, and sori [photos were taken  
 from *J.F. Maxwell* 86-283 (PSU)].



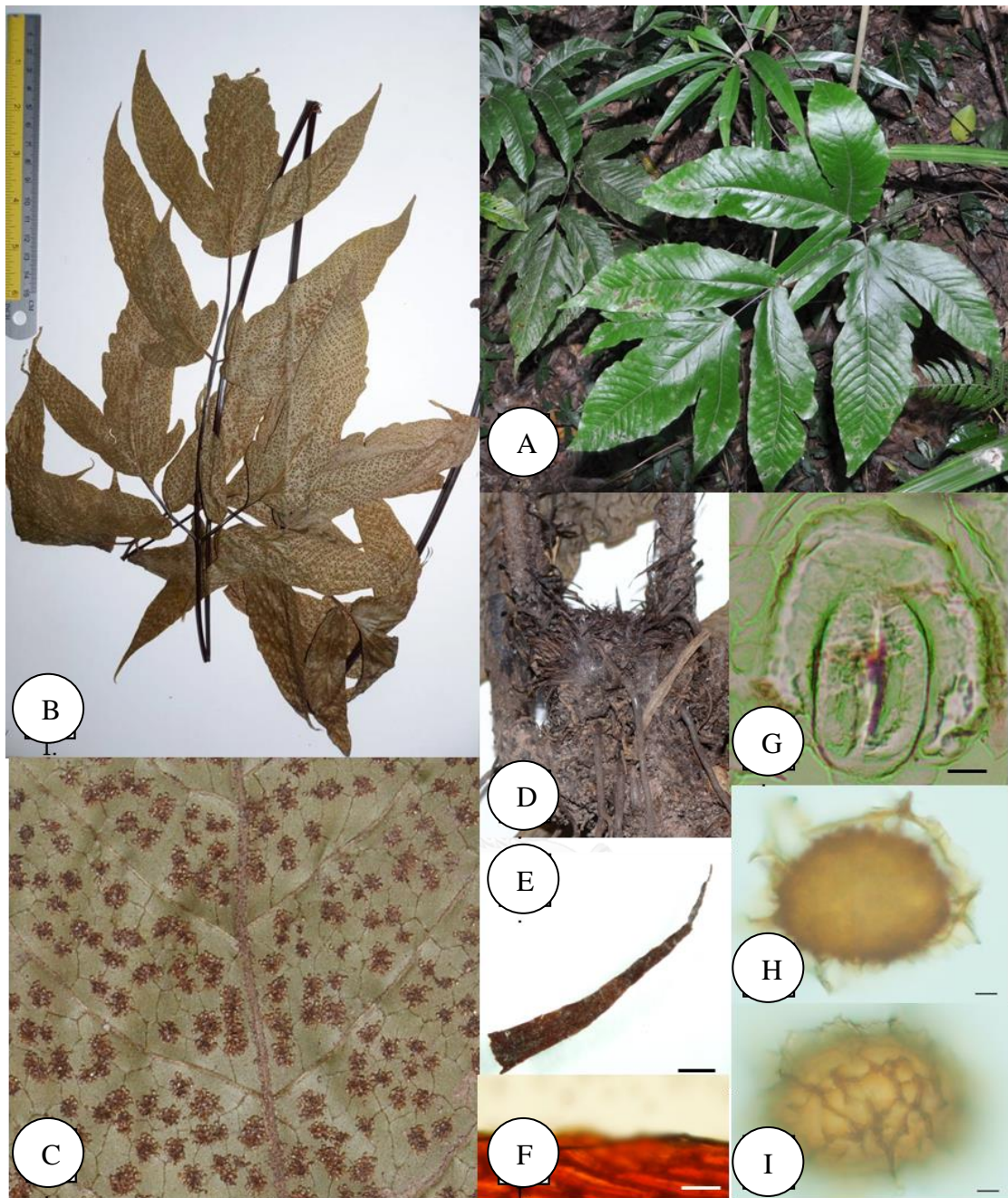


Fig. 4.36 *Tectaria simonsii*

A. natural habitat from Khao Kho district, Phetchabun province; B. fertile frond; C. venation pattern and sori [W. Ratthanathirakul 131 (BCU)]; D. rhizome; E. scale; F. scale margin; G. stoma; H. spore (optical section); and I. spore (ornamentation); [bar = 1 mm in E., 100  $\mu$ m in F., 10  $\mu$ m in G., and 5  $\mu$ m in H. & I.].

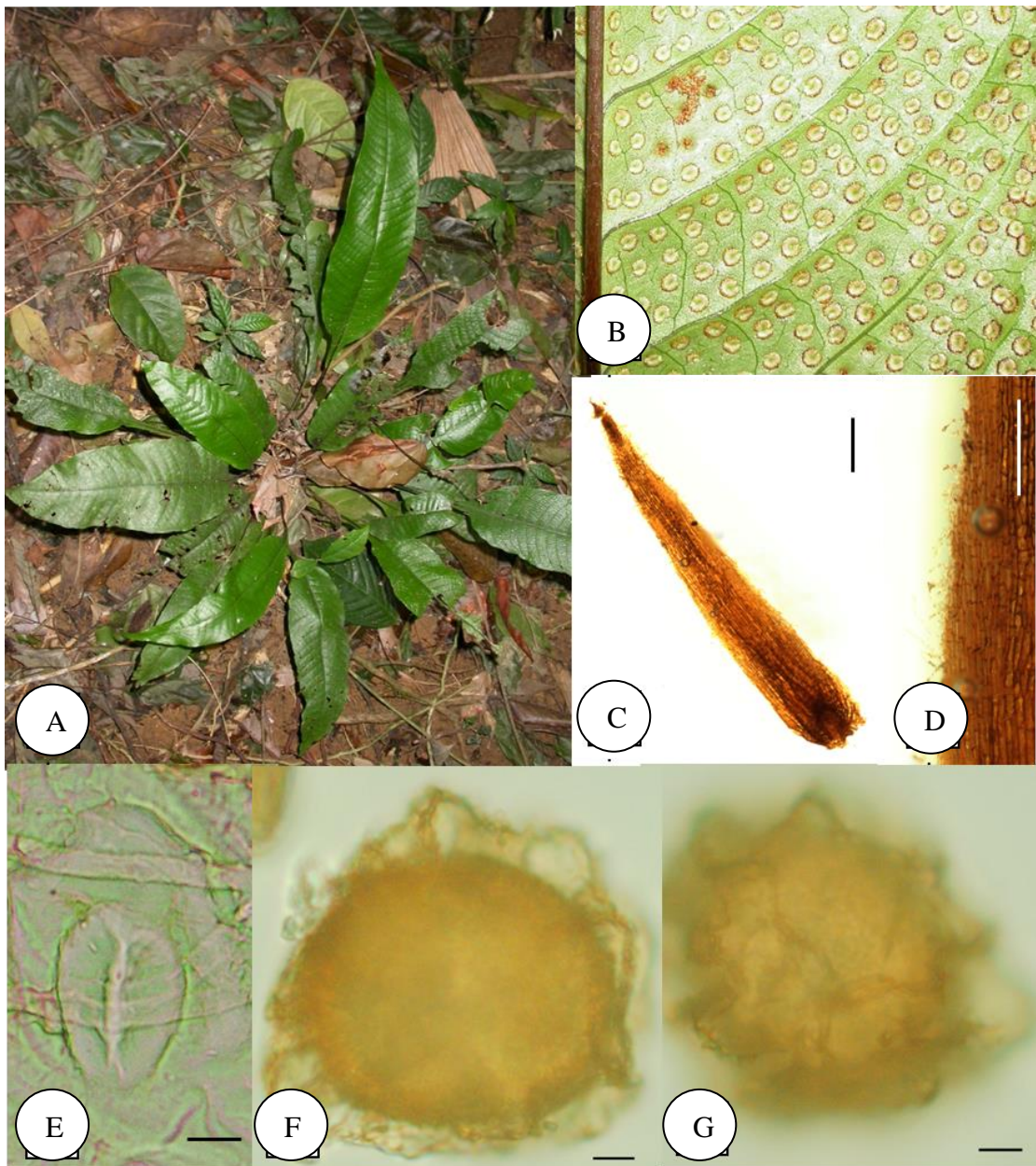


Fig. 4.37 *Tectaria singaporiana*

A. natural habitat from Khao Luang National Park, Nakhon Si Thammarat province; B. venation pattern and sori; C. scale; D. stoma; E. spore (optical section); and F. spore (ornamentation); G. scale margin; [bar = 1 mm in C., 10  $\mu$ m in D., 5  $\mu$ m in E. & F, and 500  $\mu$ m in G.].





Fig. 4.37 *Tectaria singaporeana* (continued)

H. anomalous form with irregular crenate [K. Yoda 619 (BKF), from Khao Luang National Park, Nakhon Si Thammarat province].

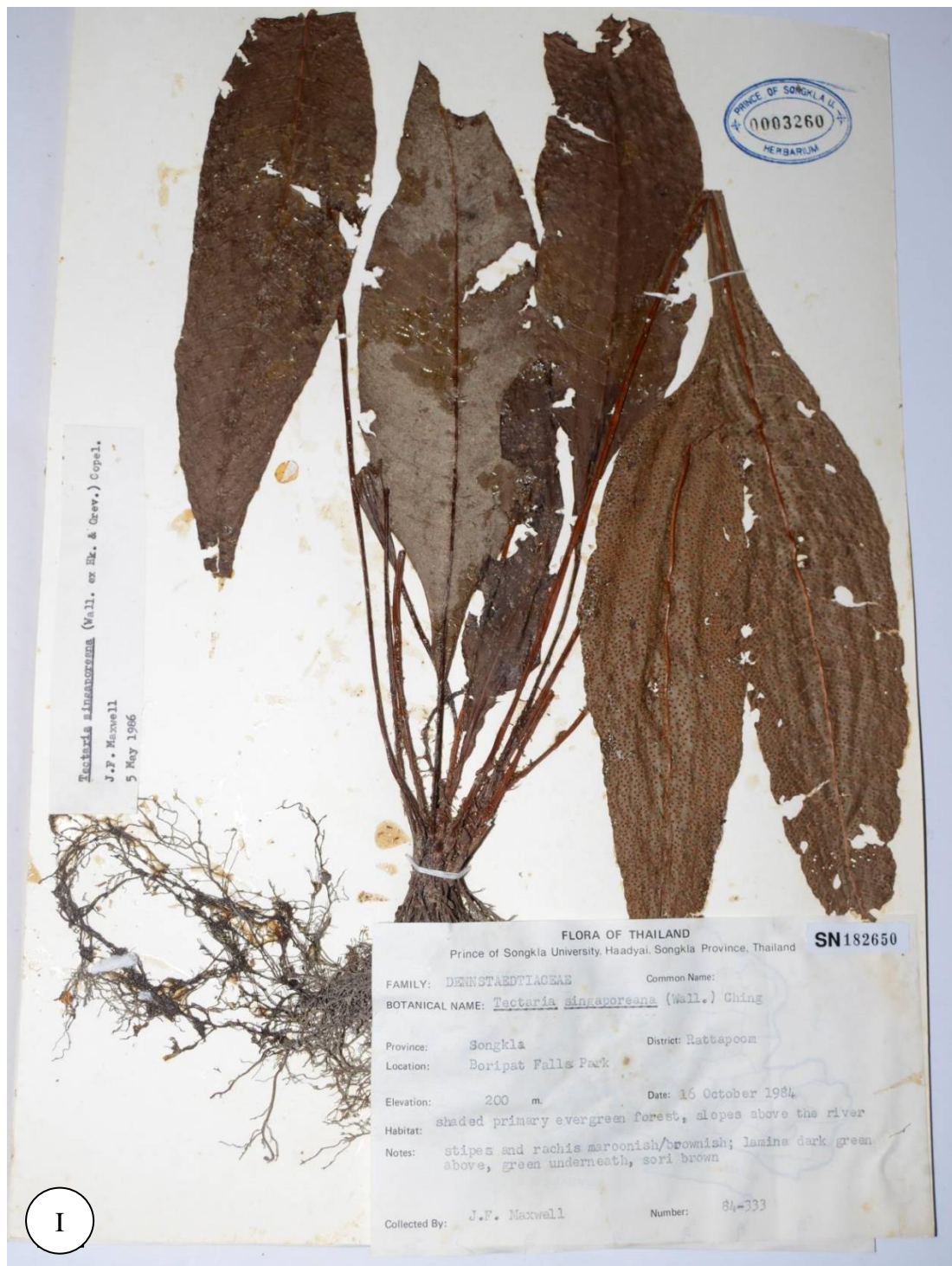


Fig. 4.37 *Tectaria singaporeana* (continued)

I. specimen with bi-lobed [J.F. Maxwell 84-333 (PSU), from Namtok Boriphat Forest Park, Songkhla province].





Fig. 4.38 *Tectaria stenosemioides*

A. habit; B. scale; C. scale margin; D. stoma; E. rhizomes with scales at apex; F. sori; and G. spore [photos were taken from *T. Boonkerd et al.* 2011-566 (BCU); bar = 1 mm in B., 100  $\mu$ m in C., 20  $\mu$ m in D., and 5  $\mu$ m in G.].

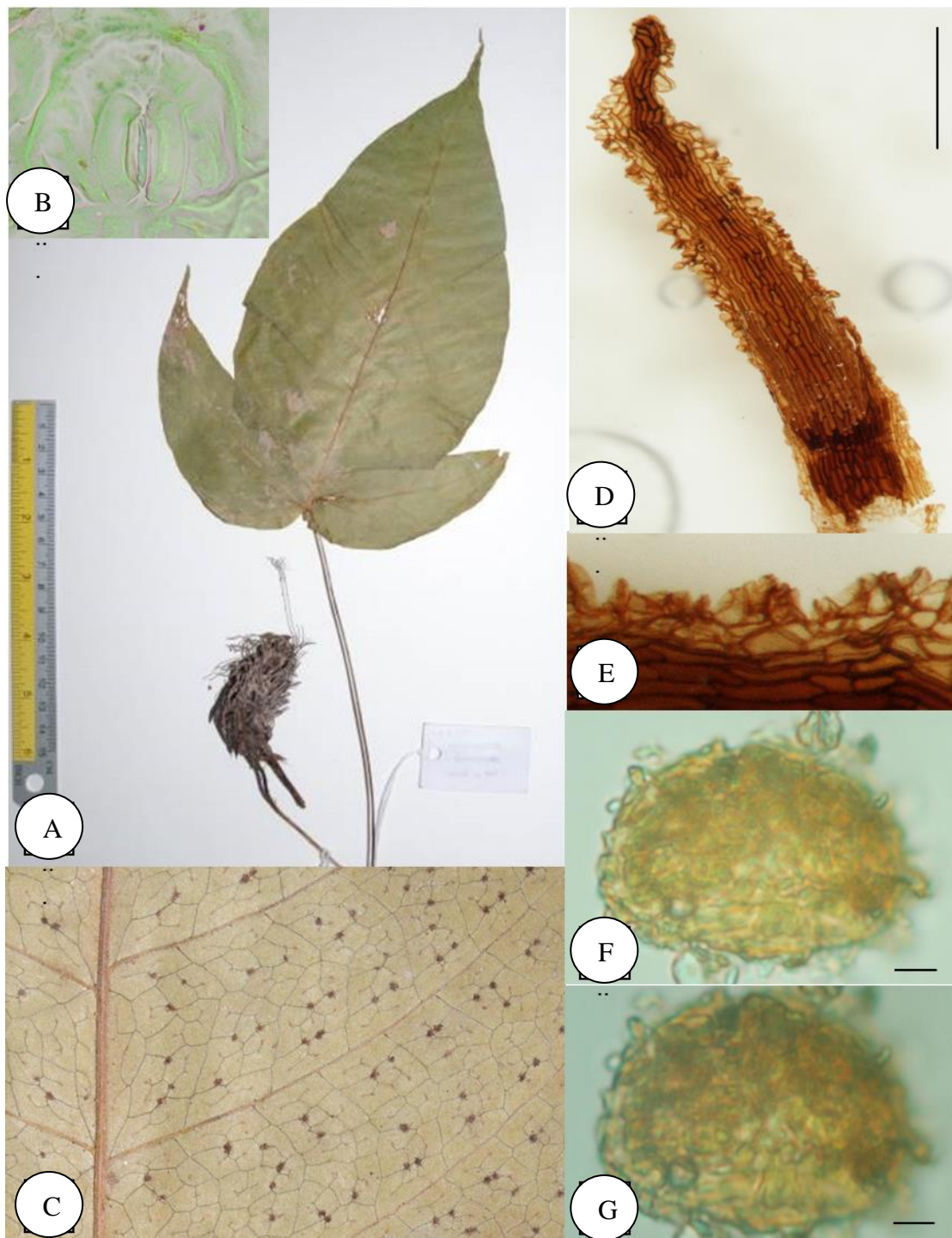


Fig. 4.39 *Tectaria subpedata*

A. habit; B. stoma; C. venation pattern and sori; D. scale; E. scale margin; F. spore (optical section); and G. spore (ornamentation) [photos were taken from *Sirisak W.* 003 (BCU), only once collection from Man Daeng Waterfalls, Phu Hin Rong Kla National Park, Loei province; bar = 20  $\mu\text{m}$  in B., 500  $\mu\text{m}$  in D., 100  $\mu\text{m}$  in E., 5  $\mu\text{m}$  in F. & G.].

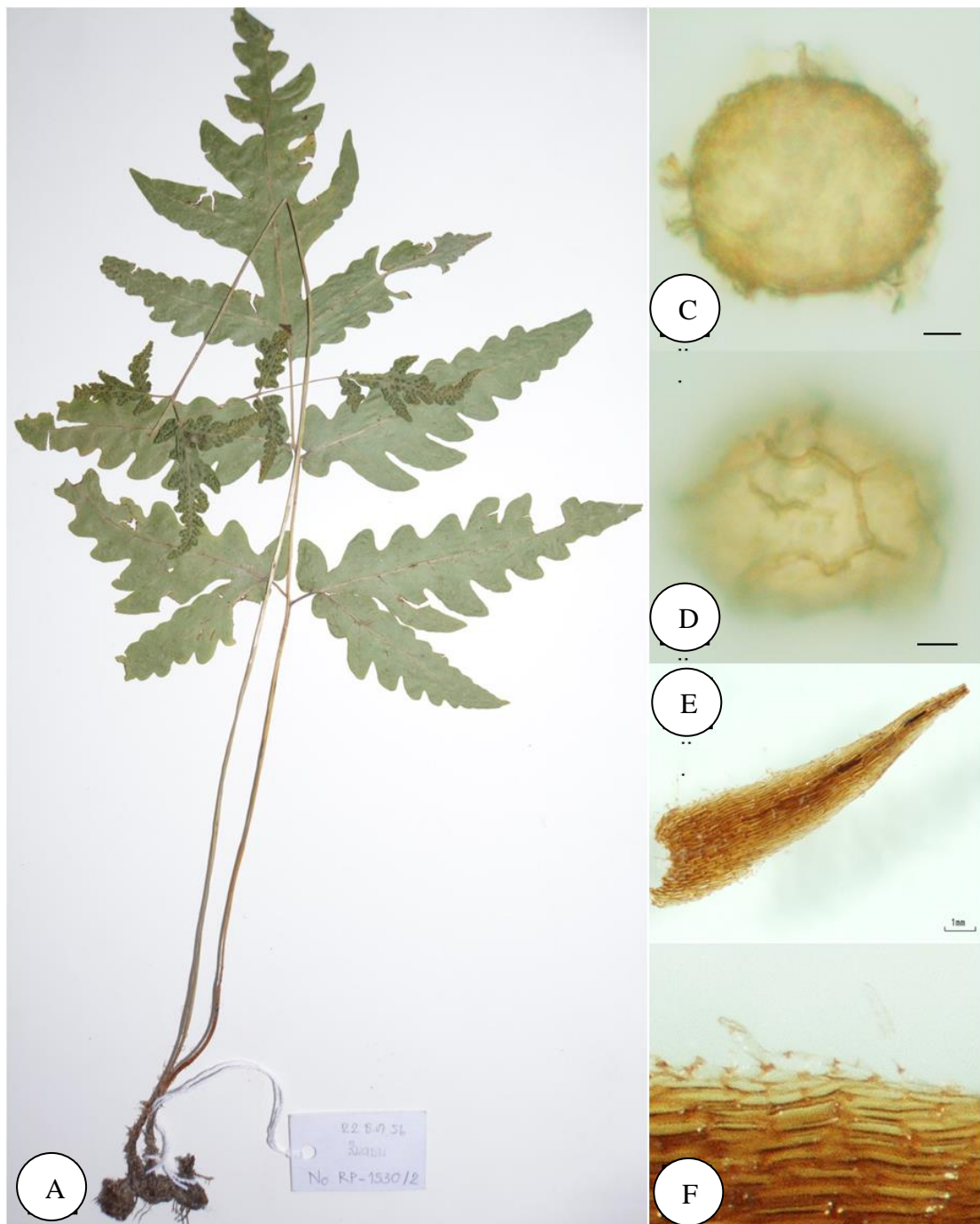


Fig. 4.40 *Tectaria subvariolosa*

A. habit; B. stoma; C. spore (optical section); D. spore (ornamentation); E. scale; and F. scale margin [photos were taken from *R. Pollawatn* 1530 (BCU); bar = 10  $\mu$ m in B., 5  $\mu$ m in C. & D., and 1 mm in E.].



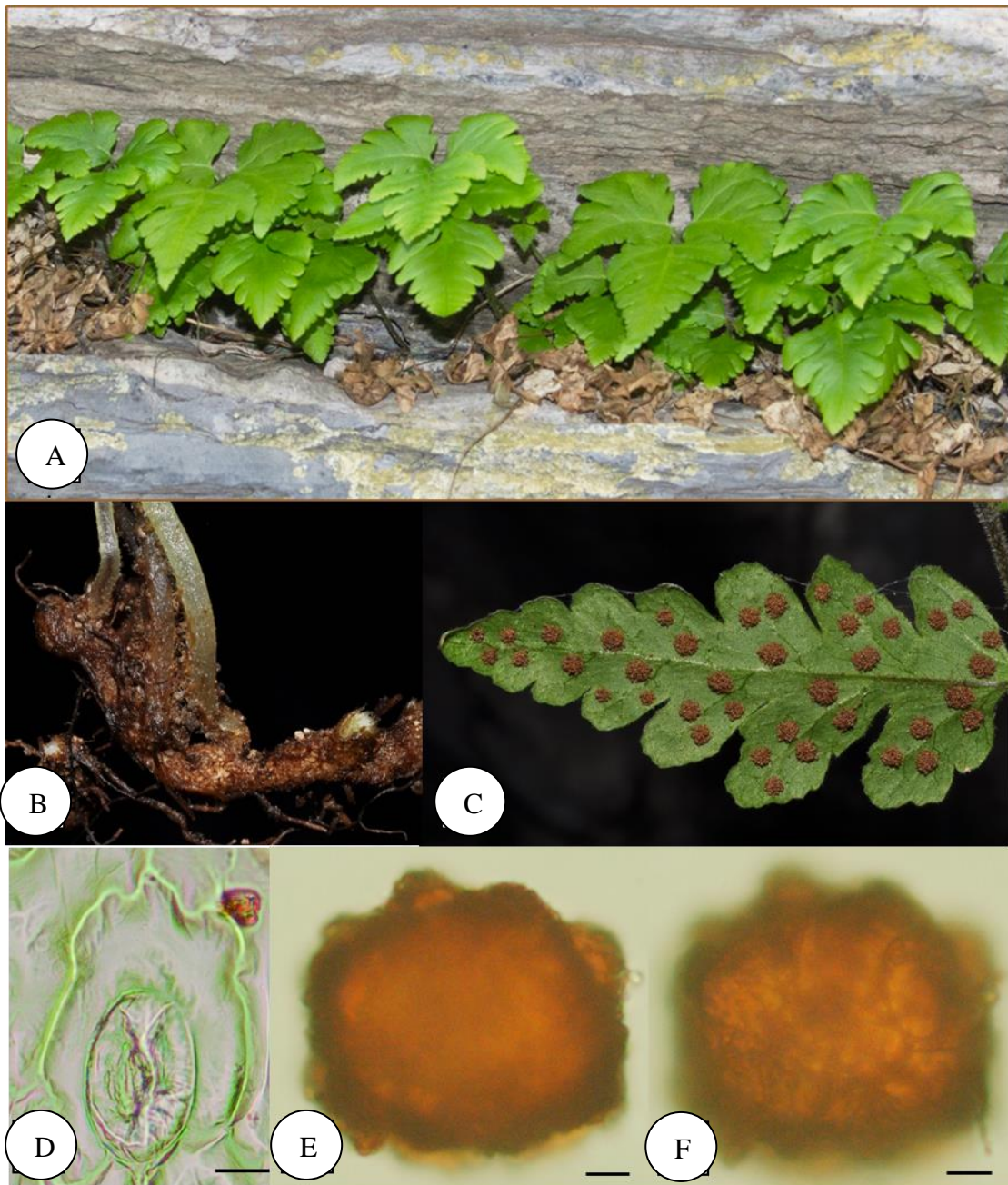


Fig. 4.41 *Tectaria tenerifrons*

A. natural habitat from Khao Noh, Nakhon Sawan province; B. creeping rhizome with dense scales at apex; C. venation pattern and sori; D. stoma; E. spore (optical section); and F. spore (ornamentation); [bar = 10  $\mu$ m in D., and 5  $\mu$ m in E. & F.].



Fig. 4.42 *Tectaria trichotoma*

A. fertile frond; B. sori; and C. scales at stipe [photos were taken from *D.J. Middleton, C. Hemrat, S. Lindsay, S. Suddee, and S. Suwanachat 3324 (BKF)*, only once collection from Kaeng Krachan National Park, Phetchaburi province.



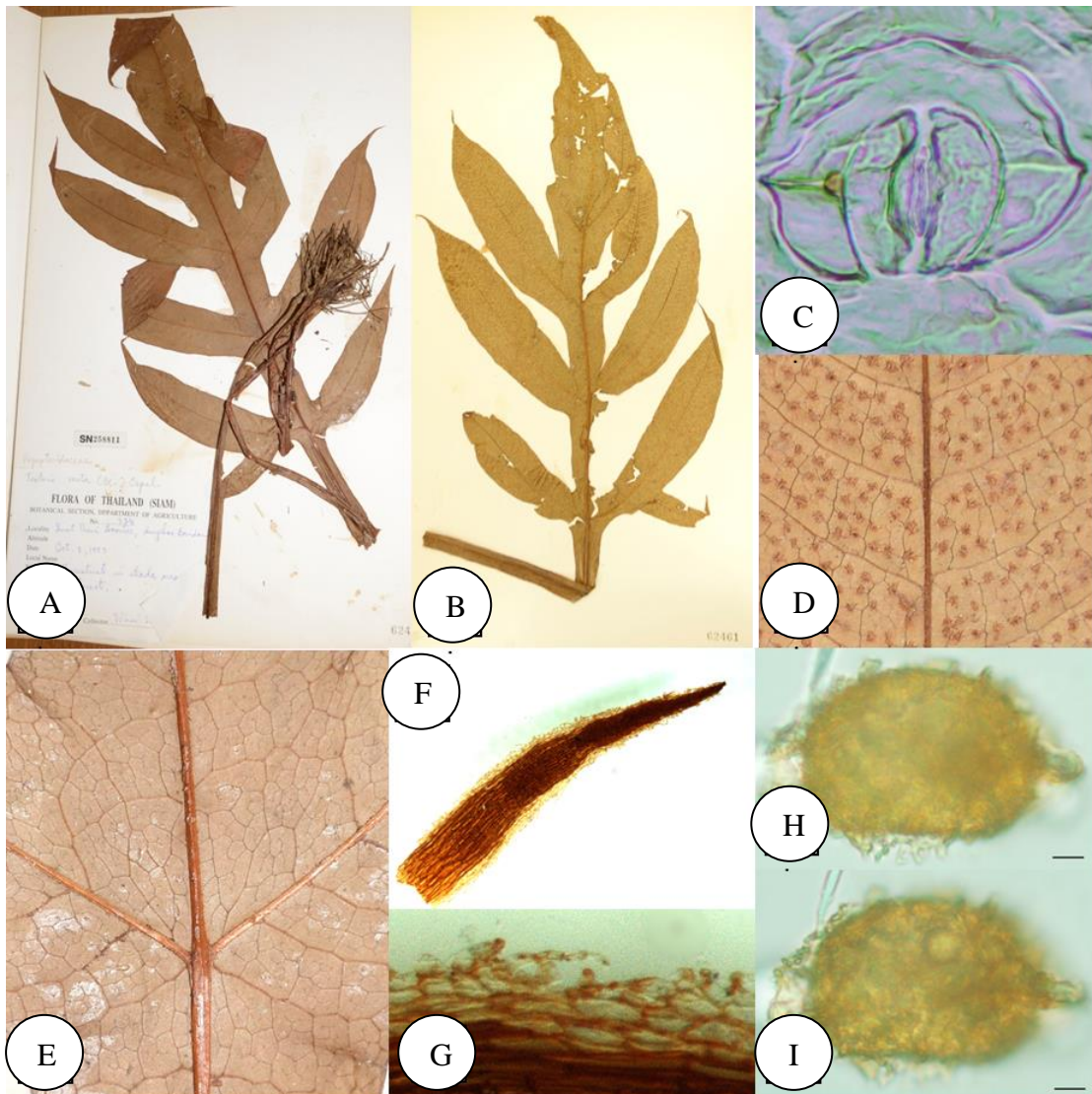


Fig. 4.43 *Tectaria vasta*

A. sterile frond; B. fertile frond; C. stoma; D. sori; E. venation pattern; F. scale; G. scale margin; H. spore (optical section); and I. spore (ornamentation) [bar = 1 mm in F., 100  $\mu$ m in G., 10  $\mu$ m in H., and 5  $\mu$ m in I. & J.].



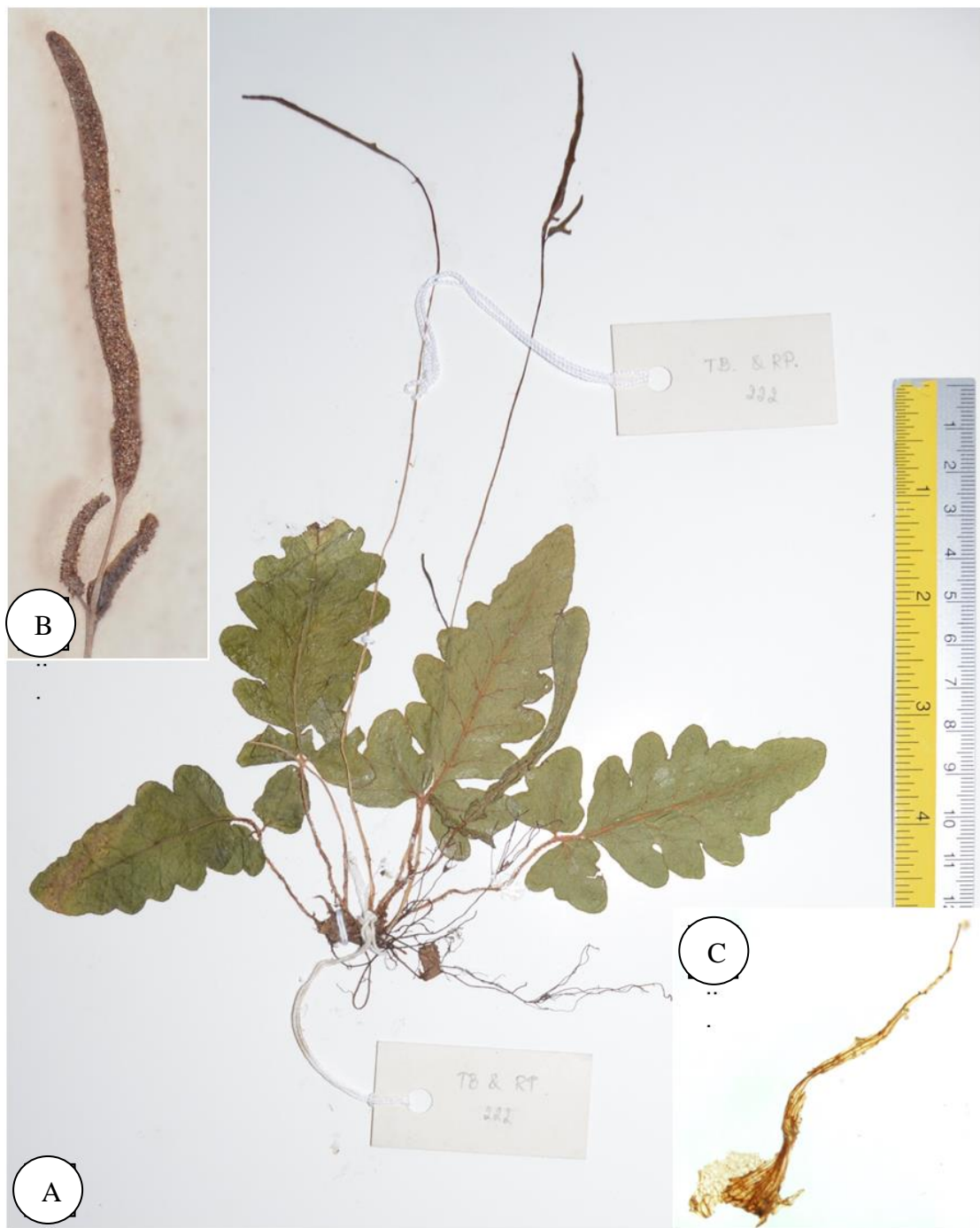


Fig. 4.44 *Tectaria zeilanica*

A. habit; B. sori; and C. scale [photos of A. & C. were taken from *T. Boonkerd & R. Pollawatn 222* (BCU) and B. was taken from *Winit 1025* (BKF); bar = 500 µm in C.].

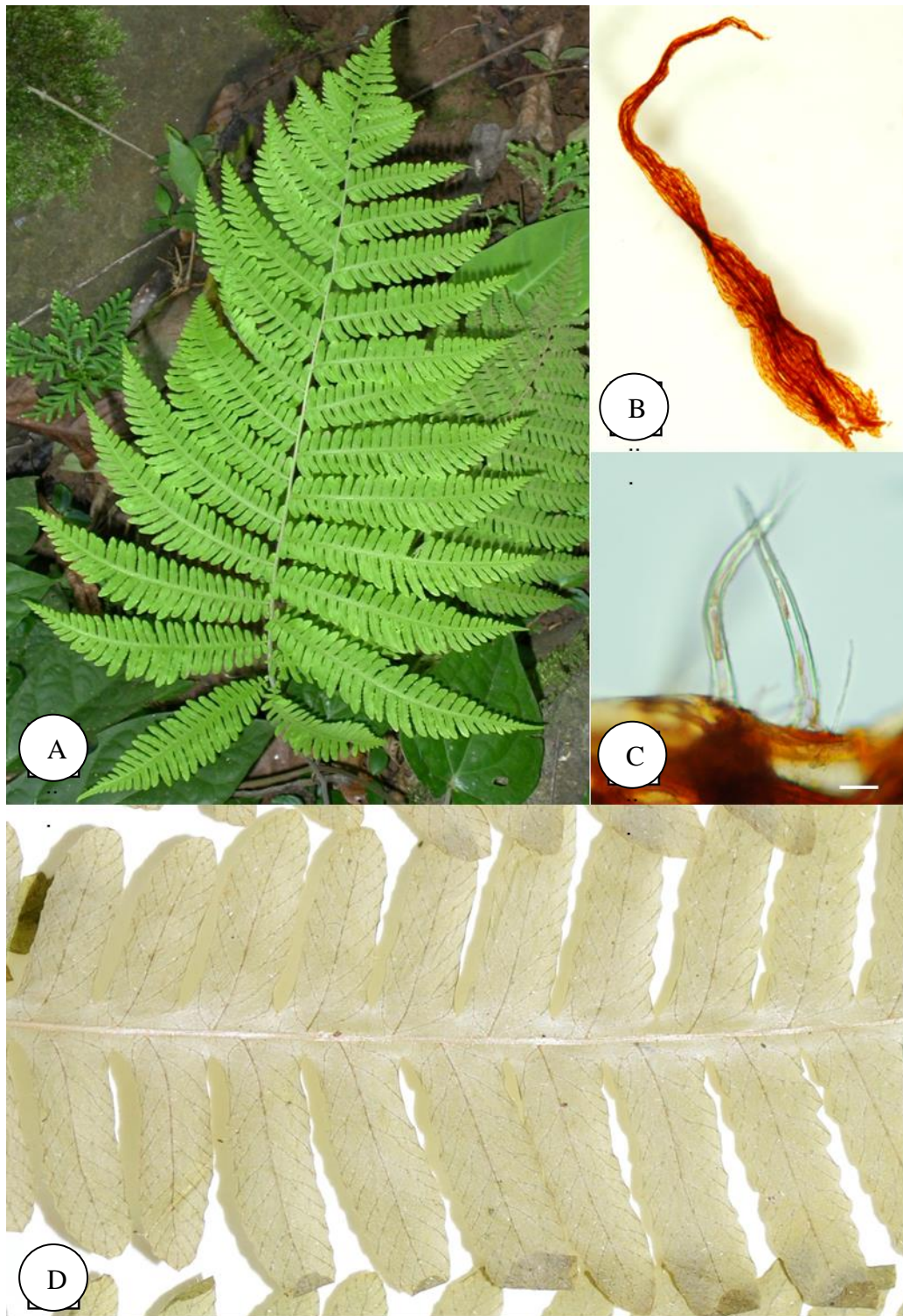


Fig. 4.45 *Tectaria zippelii*

A. natural habitat at Khao Nan National Park, Nakhon Si Thammarat province; B. scale; C. scale margin with unicellular hairs; and D. venation pattern (bar = 1 mm in B., and 20  $\mu$ m in C.).



Fig. 4.46 *Tectaria* sp.1

A. habit; and B. sori [photos were taken from *K. Williams, R. Pooma, M. Poopath, V. Chamchumroon* 1372 (BKF), only once collection from Ratsada district, Trang province].





Fig. 4.47 *Tectaria* sp.2

A. sterile frond; B. fertile frond; C. rhizome; D. scale; and E. venation pattern and sori [photos were taken from *D.J. Middleton, C. Hemrat, S. Lindsay, S. Suddee & S. Suwanachat 3427 (BKF)*, only once collection from Kaeng Krachan National Park, Phetchaburi province].

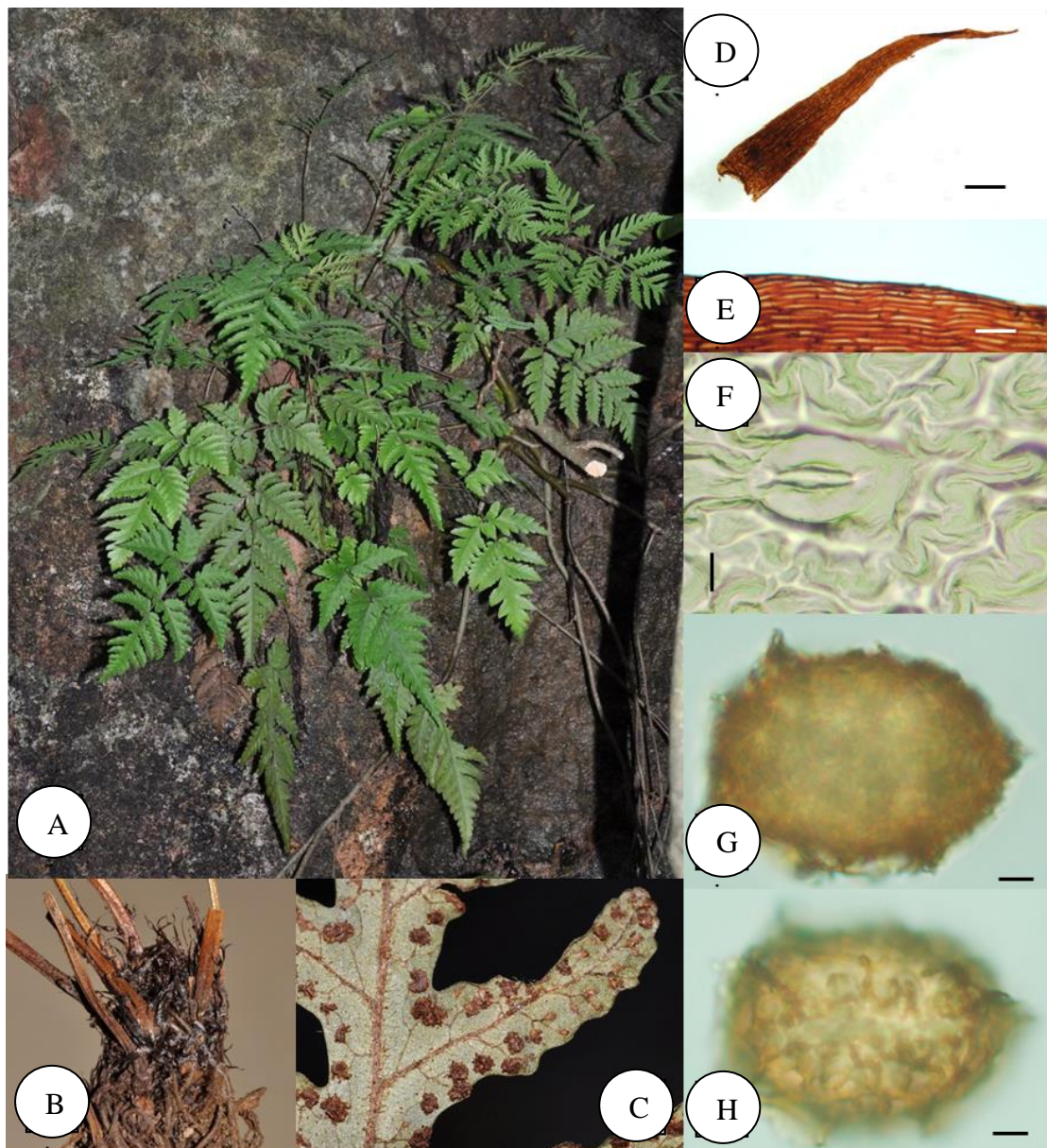


Fig. 4.48 *Tectaria* sp.3

A. natural habitat from Khao Chakan, Sa Kaeo province; B. rhizome with dense scales at apex; C. venation pattern and sori; D. scale; E. scale margin; F. stoma; G. spore (optical section); and H. spore (ornamentation); [bar = 1 mm in D., 100  $\mu$ m in E., 10  $\mu$ m in F. and 5  $\mu$ m in G. & H.].



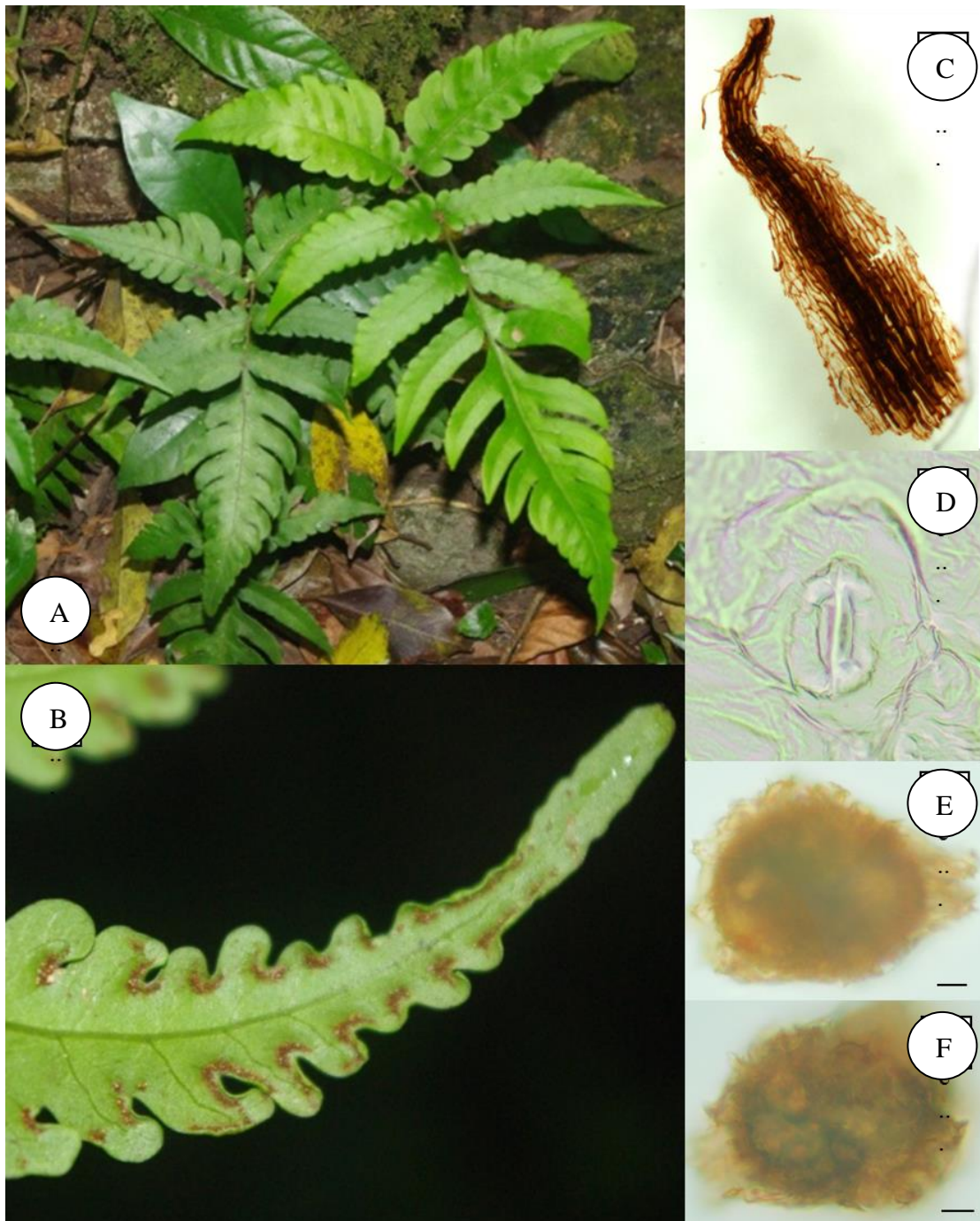


Fig. 4.49 *Tectaria* sp.4

A. natural habitat at Tham Nam Wang Si Thammasokarat, Lan Saka district, Nakhon Si Thammarat province; B. sori; C. scale; D. stoma; E. spore (optical section); and F. spore (ornamentation) (bar = 10  $\mu$ m in D., 5  $\mu$ m in E. & F.).

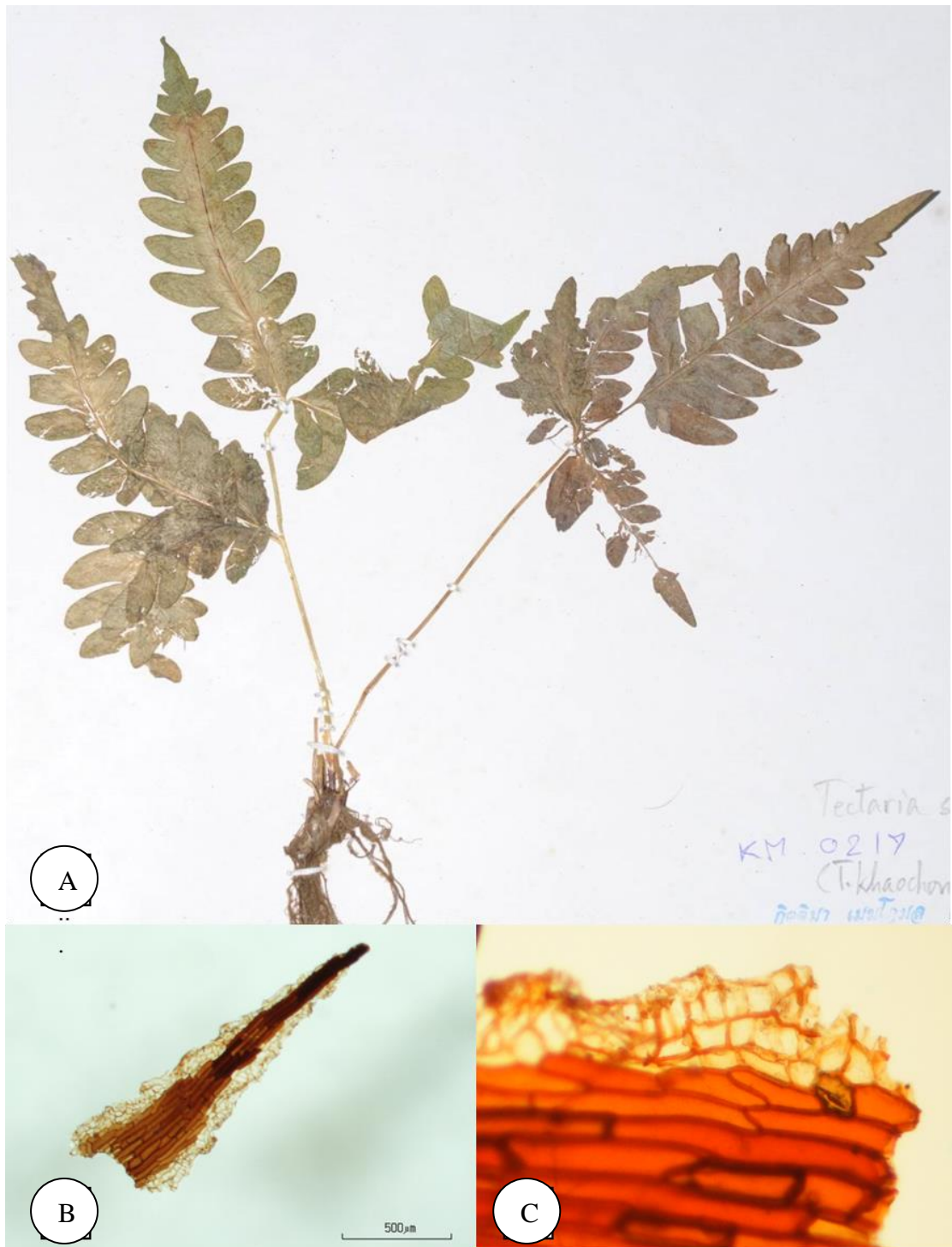


Fig. 4.50 *Tectaria* sp.5  
 A. habit, only once collection from Khao Ka Chong, Trang province; B. scale; and C. scale margin [photos were taken from *Kittima* 51 (KKU), bar = 500  $\mu$ m in B.].

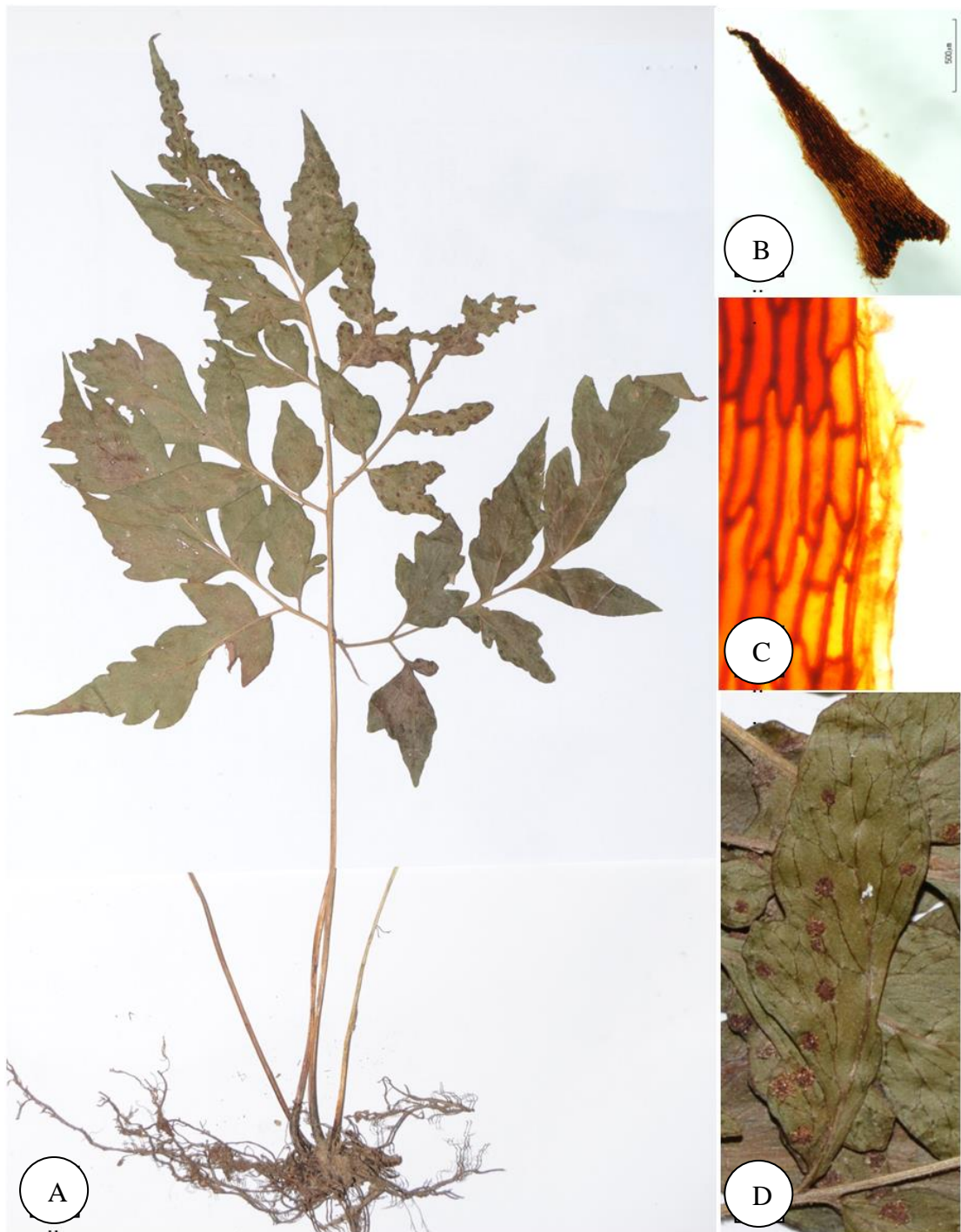


Fig. 4.51 *Tectaria* sp.6  
A. habit, only once collection from Nam Nao National Park, Phetchabun province; B. scale; C. scale margin; and D. venation pattern and sori [photos were taken from *s.coll.* 21 (KKU); bar = 500  $\mu$ m in B.].



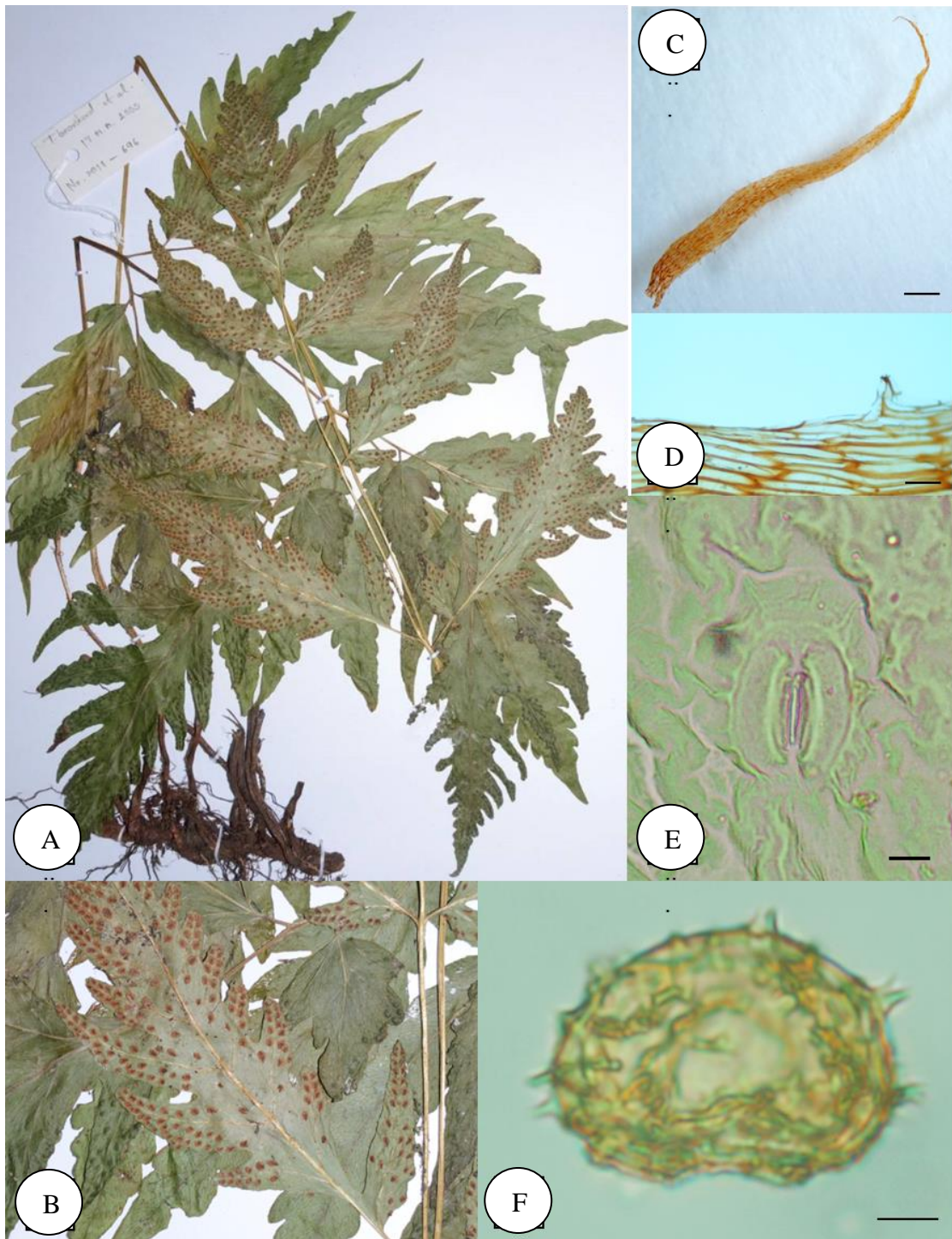


Fig. 4.52 *Tectaria* sp.7

A. habit, only found at Nong Hin district, Loei province; B. sori; C. scale; D. scale margin; E. stoma; and F. spore [photos were taken from *T. Boonkerd et al.* 2011-696 (BCU); bar = 100  $\mu\text{m}$  in C., 20  $\mu\text{m}$  in D., 10  $\mu\text{m}$  in E., and 5  $\mu\text{m}$  in F.].

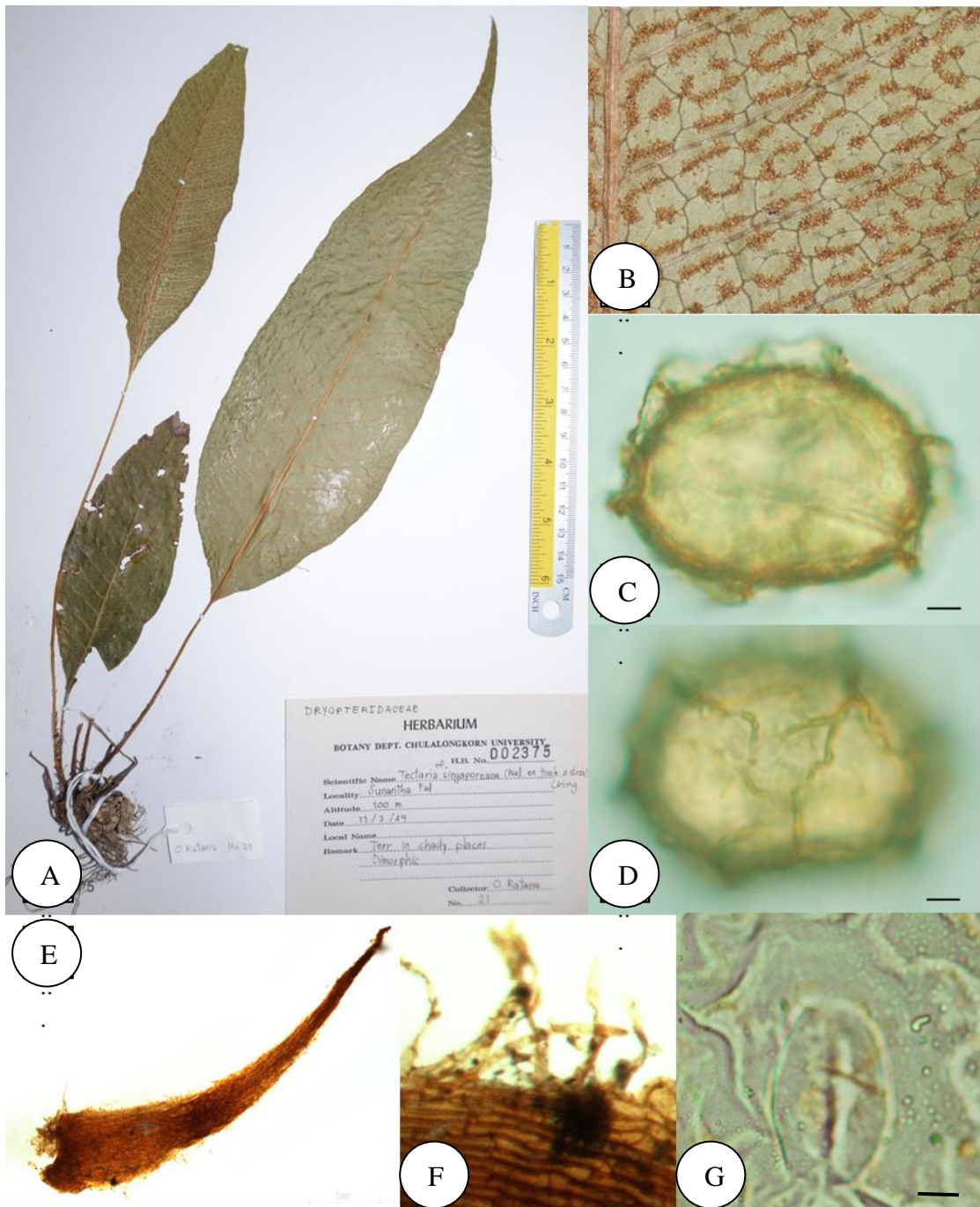


Fig. 4.53 *Tectaria* sp.8

A. habit, located from Sunantha Waterfalls, Khao Nan National Park, Nakhon Si Thammarat province; B. sori; C. spore (optical section); D. spore (ornamentation); E. scale; F. scale margin with multicellular filamentous hairs; and G. stoma [photos were taken from *O. Ratana* 21 (BCU); bar = in B., 5  $\mu$ m in C. & D., 1 mm in E., and 10  $\mu$ m in G.].



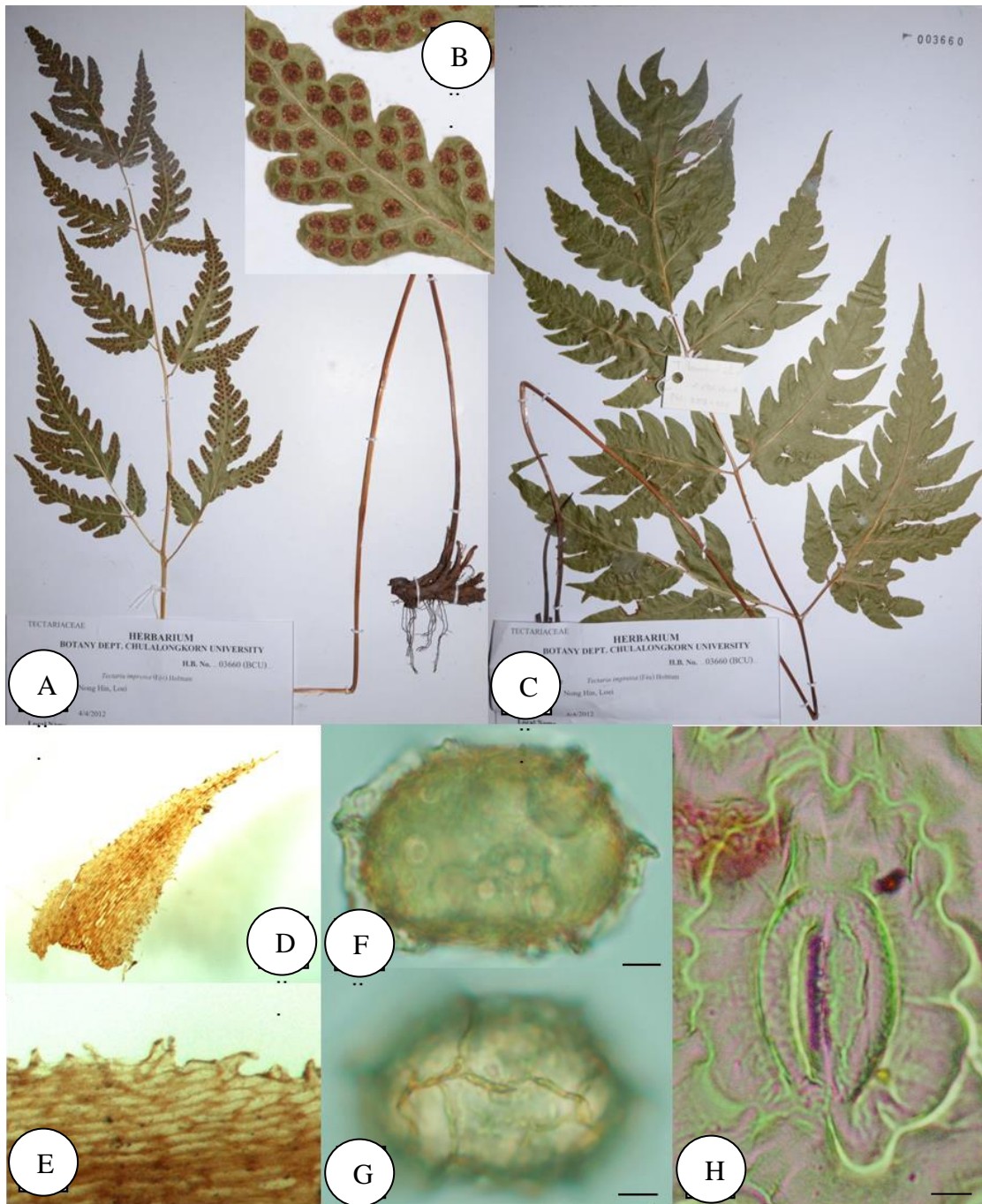


Fig. 4.54 *Tectaria* sp.9

A. fertile frond; B. sori; C. sterile frond; D. scale; E. scale margin; F. spore (optical section); G. spore (ornamentation); and H. stoma [photos were taken from *T. Boonkerd et al.* 2011-535 (BCU), only found at Nong Hin district, Loei province; bar = 5  $\mu$ m in F. & G., and 10  $\mu$ m in H.].

## CHAPTER V

### DISCUSSION AND CONCLUSION

#### 5.1 Morphological, anatomical, and palynological characteristics of Thai *Tectaria*

In general, morphological characteristics among *Tectaria* species are variously diverse. Rhizomes resemble in erect, ascending to creeping form. Apex of rhizomes usually covered with scales. Stipe color are varied from stramineous to nearly black. Fronds are monomorphic or dimorphic, with simple to pinnately compound laminae. Venation patterns are fully free veins to fully anastomosing veins with or without free included veinlets in each areoles. Sori are usually round and covered with indusia. Some species have acrostichoid sori. Their morphological details are listed in Table 5.1.

Anatomical and palynological studies in species complex were achieved. The results show that the vascular strands are concentric, consisting of a central strip of xylems with the surrounding of phloems. These vascular bundles are embbed radially within ground parenchymatous tissue (Fig. 5.1). Interestingly, the number and vascular bundle arrangement in stipe are poorly significant in differentiating the related species, since a number of vascular bundle are varied even in the same stipe of the same species, e.g. *T. herpetocaulos* (Fig. 5.2). Likewise, stomatal apparatus is polocytic in all Thai *Tectaria* species, excepting copolocytic in *T. griffithii* and *T. multicaudata* (Fig. 5.3). That is to say, this character cannot be used for species delimitation in the Thai *Tectaria*. Spores are monolete, ellipsoid, spheroidal, or kidney shape. Their sizes are 20.0-(32.7)-47.5  $\mu\text{m}$  in polar axis and 25.0-(43.3)-65.0  $\mu\text{m}$  in equatorial axis. Spore characteristics can be used to segregate some related species, especially perispore ornamentation (Fig. 5.4).

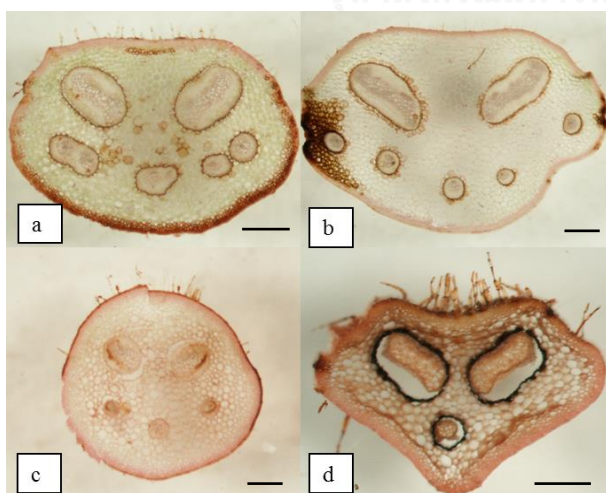


Fig. 5.1 x-section at terminal part of stipes in some *Tectaria* species, showing the radial vascular bundle arrangement; photos were taken from stipe of *T. brachiata* (a), *T. impressa* (b), *T. devexa* (c), and *T. sp.3* (d) (bar = 500  $\mu\text{m}$ ).



Fig. 5.2 Vascular bundle arrangement at basal, middle & terminal of stipe of *T. herpetocaulos* [Sirisak W. 060 (BCU)] (bar = 1 mm).

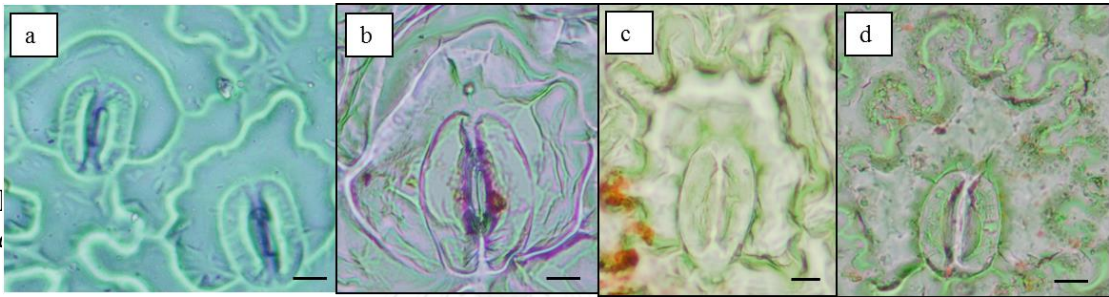


Fig. 5.3 polocytic stomatal type of some *Tectaria* species, *T. herpetocaulos* (a), *T. decurrens* (b), *T. devexa* (c), and *T. impressa* (b) (bar = 10  $\mu$ m).

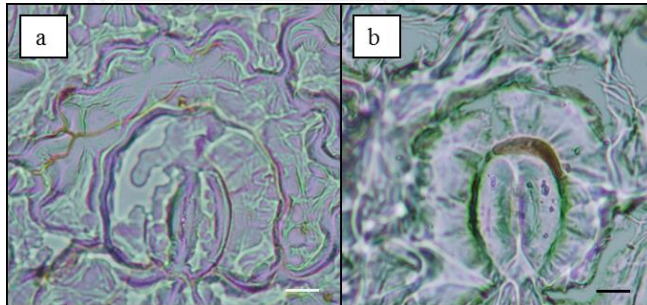


Fig. 5.4 copolocytic stomatal type of some *Tectaria* species, *T. griffithii* (a), and *T. multicaudata* (b) (bar = 10  $\mu$ m).



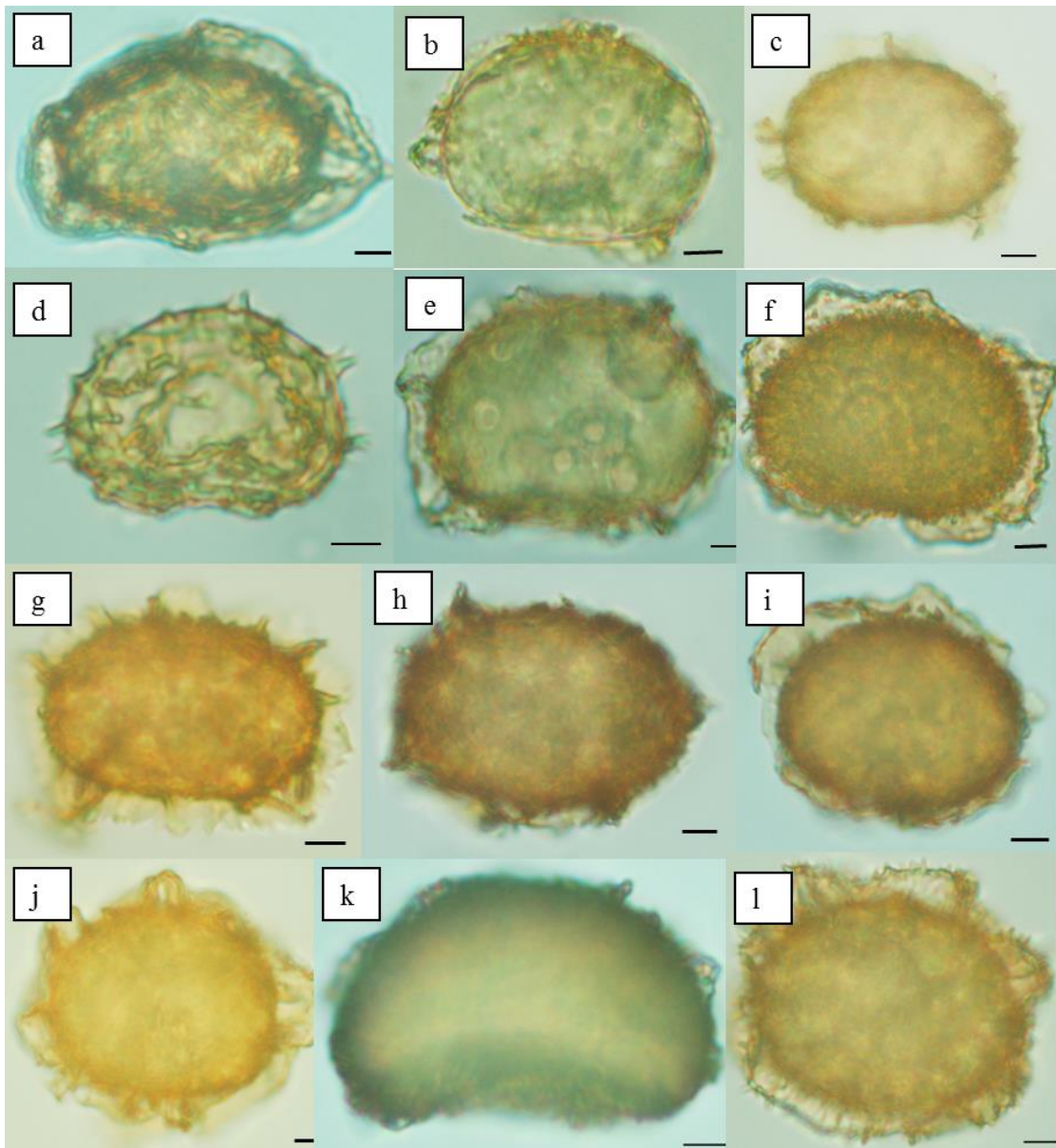


Fig. 5.5 Spores of some *Tectaria* species; a. *T. brachiata*, b. *T. impressa*, c. *T. subvariolosa*, d. *T. sp.7*, e. *T. sp.9*, f. *T. coadunata*, g. *T. devexa*, h. *T. sp.3*, i. *T. remotipinna*, j. *T. phaeocaulis*, k. *T. acrocarpa*, and l. *T. fuscipes* (bar = 5  $\mu$ m).

Table 5.1 Morphological characters of *Tectaria* in Thailand.

No.	Species	Rhizome	Scale shape	Scale color	Stipe color
1.	<i>T. acrocarpa</i>	erect	lanceolate	bicolored, castaneous centrally with paler margin	dull dark stramineous
2.	<i>T. angulata</i>	erect to ascending	linear-lanceolate	bicolored, dark brown centrally with paler margin	castaneous to dark brown, rarely nearly black
3.	<i>T. aurita</i>	erect	linear-lanceolate	concolorous, dark brown to castaneous	dark brown to castaneous
4.	<i>T. barberi</i>	erect to ascending	linear-lanceolate	concolorous, dark brown	dark stramineous to castaneous
5.	<i>T. brachiata</i>	erect to ascending	lanceolate	concolorous, dark brown	stramineous to light brown
6.	<i>T. chattagramica</i>	erect	linear-lanceolate	concolorous, dark brown to castaneous	dark brown to castaneous
7.	<i>T. coadunata</i>	erect, ascending to creeping	ovate	bicolored, dark brown centrally with paler margin	stramineous to brown
8.	<i>T. crenata</i>	erect	lanceolate	concolorous, dark brown	stramineous to dull brown
9.	<i>T. decurrens</i>	erect	lanceolate	bicolored, light brown to dark brown centrally with paler brown ferruginous margin	stramineous to dull brown



No.	Species	Rhizome	Scale shape	Scale color	Stipe color
10.	<i>T. devexa</i>	erect	linear-lanceolate	concolorous, castaneous to dark brown	dark brown to dull castaneous
11.	<i>T. fauriei</i>	erect	lanceolate	bicolored, castaneous to dark brown with narrowly paler margin	stramineous to dull brown
12.	<i>T. fissa</i>	erect	lanceolate	bicolored, dark brown centrally with narrowly paler margin	castaneous to dark dull brown
13.	<i>T. fuscipes</i>	erect to ascending	lanceolate	bicolored, dark brown at central portion with narrow ferruginous paler margin	stramineous to dark dull brown
14.	<i>T. griffithii</i>	erect to ascending	lanceolate	concolorous, dark brown to castaneous	dark brown to castaneous
15.	<i>T. gymnosora</i>	erect	lanceolate	bicolored, dark brown at central portion with paler brown ferruginous margin	dark brown to castaneous
16.	<i>T. hennipmanii</i>	n/a	lanceolate	concolorous, pale brown to light brown	castaneous to dull brown
17.	<i>T. herpetocaulos</i>	creeping	lanceolate	bicolored, dark brown centrally with narrowly paler margin	stramineous to dull brown

No.	Species	Rhizome	Scale shape	Scale color	Stipe color
18.	<i>T. hymenophylla</i>	n/a	n/a	n/a	stramineous to pale brown
19.	<i>T. impressa</i>	creeping or suberect	lanceolate	bicolored, dark brown centrally with paler margin	stramineous to dark brown
20.	<i>T. keckii</i>	erect	linear-lanceolate	concolorous, deep castaneous	castaneous to dark brown
21.	<i>T. kehdingiana</i>	erect to ascending	lanceolate	bicolored, shining brown with paler margin	castaneous
22.	<i>T. laotica</i>	erect	lanceolate	concolorous, deep castaneous	deep castaneous to purplish, polished
23.	<i>T. manilensis</i>	creeping	ovate	concolorous, dark brown	stramineous to pale brown
24.	<i>T. melanocaula</i>	erect	linear-lanceolate	concolorous, castaneous	deep purplish to nearly black, glossy
25.	<i>T. multicaudata</i>	erect to ascending	linear-lanceolate	concolorous, dark brown to castaneous	pale brown to castaneous
26.	<i>T. nayarii</i>	erect	linear-lanceolate	concolorous, dark brown to castaneous	dark brown to castaneous
27.	<i>T. phaeocaulis</i>	creeping	linear-subtriangular	bicolored, dark brown centrally with narrowly paler margin	castaneous to pale brown
28.	<i>T. phanomensis</i>	erect	lanceolate-subtriangular	concolorous, pale castaneous	brown to pale castaneous

No.	Species	Rhizome	Scale shape	Scale color	Stipe color
29.	<i>T. poilanei</i>	erect	ovate-lanceolate	bicolored, castaneous to dark brown centrally with narrowly paler brown margin	castaneous to dark glossy brown
30.	<i>T. polymorpha</i>	erect to ascending	linear-lanceolate	bicolored, castaneous to dark brown centrally with narrowly paler brown margin	stramineous to pale dull brown
31.	<i>T. remotipinna</i>	erect to ascending	linear-lanceolate	bicolored, dark brown centrally with paler margin	stramineous to pale brown
32.	<i>T. rockii</i>	erect to ascending	linear-lanceolate	concolorous, brown	stramineous to light brown adaxially, deeper brown and grooved abaxially
33.	<i>T. sagenioides</i>	erect	ovate-lanceolate	dark brown at central portion with ferruginous margin	deep castaneous to nearly black, rarely greenish, glossy

No.	Species	Rhizome	Scale shape	Scale color	Stipe color
34.	<i>T. semipinnata</i>	erect	lanceolate	bicolored, dark brown to castaneous at central part with narrowly paler ferruginous edge	brown to castaneous, glossy
35.	<i>T. siifolia</i>	erect to ascending	linear- lanceolate	dark brown centrally with narrow paler margin	stramineous to pale castaneous
36.	<i>T. simonsii</i>	erect to ascending	lanceolate	concolorous, deep castaneous to dark brown	mostly purplish to nearly black, sometimes dark brown
37.	<i>T. singaporiana</i>	erect	lanceolate	concolorous, dark brown	castaneous
38.	<i>T. stenosemioides</i>	erect	linear- lanceolate	dark brown centrally with paler margin	castaneous to dark brown
39.	<i>T. subpedata</i>	erect to ascending	linear- lanceolate	dark brown centrally with narrowly paler margin	stramineous to dark dull brown
40.	<i>T. subvariolosa</i>	creeping	ovate- lanceolate	bicolored, dark brown centrally with ferruginous paler margin	stramineous to pale brown

No.	Species	Rhizome	Scale shape	Scale color	Stipe color
41.	<i>T. tenerifrons</i>	creeping	ovate	concolorous, brown	stramineous to pale brown
42.	<i>T. trichotoma</i>	ascending	lanceolate	bicolored, dark brown at central portion with narrow paler margin	dark dull brown
43.	<i>T. vasta</i>	erect	ovate- subtriangular	bicolored, dark brown centrally with narrowly paler brown margin	dark dull brown to castaneous
44.	<i>T. zeilanica</i>	creeping	ovate	concolorous, dark brown	pale stramineous to dull brown
45.	<i>T. zippelii</i>	erect	linear- lanceolate	concolorous, dark brown	stramineous to pale brown
46.	<i>T. sp.1</i>	erect to ascending	lanceolate	concolorous, dark brown	dark brown
47.	<i>T. sp.2</i>	erect to ascending	lanceolate	concolorous, dark brown	dark brown
48.	<i>T. sp.3</i>	erect	lanceolate to triangular	concolorous, dark brown to castaneous	stramineous to light brown
49.	<i>T. sp.4</i>	erect	lanceolate to triangular	bicolored, shining dark brown centrally with paler margin	castaneous
50.	<i>T. sp.5</i>	erect	lanceolate	bicolored, dark brown centrally with narrowly paler margin	stramineous to pale brown



No.	Species	Rhizome	Scale shape	Scale color	Stipe color
51.	<i>T. sp.6</i>	erect	lanceolate	concolorous, dark brown	stramineous to dull brown
52.	<i>T. sp.7</i>	creeping	lanceolate to subtriangular	bicolored, dark brown centrally with brown ferruginous margin	stramineous to pale brown
53.	<i>T. sp.8</i>	ascending to suberect	lanceolate	concolorous, dark brown	stramineous to pale brown
54.	<i>T. sp.9</i>	ascending to short- creeping	lanceolate	dark brown centrally with paler ferruginous margin	stramineous to light brown

Table 5.1 (Continued) Morphological characters of *Tectaria* in Thailand.

No.	Species	Frond	Lamina	Venation	Sori shape
1.	<i>T. acrocarpa</i>	slightly dimorphic	bipinnatifid	all free	round, indusiate
2.	<i>T. angulata</i>	monomorphic	unipinnate	anastomosing	round, indusiate
3.	<i>T. aurita</i>	dimorphic	bipinnatifid	pinnate, hardly visible	acrostichoid
4.	<i>T. barberi</i>	monomorphic	unipinnate	anastomosing	round, indusiate
5.	<i>T. brachiata</i>	dimorphic	bipinnatifid to bipinnate at base, bipinnatifid upwards	anastomosing	round, indusiate
6.	<i>T. chattagramica</i>	dimorphic	bipinnatifid	anastomosing	round, indusiate
7.	<i>T. coadunata</i>	monomorphic	bipinnatifid to bipinnate at base, bipinnatifid upwards	anastomosing	round, indusiate
8.	<i>T. crenata</i>	monomorphic	unipinnate	anastomosing	round, indusiate
9.	<i>T. decurrens</i>	monomorphic	simple, pinnatifid	anastomosing	round, indusiate
10.	<i>T. devexa</i>	monomorphic	bipinnatifid to tripinnatifid at base, bipinnatifid to bipinnate upwards	partly anastomosing	round, indusiate
11.	<i>T. fauriei</i>	monomorphic	simple, pinnatifid	anastomosing	round, indusiate
12.	<i>T. fissa</i>	monomorphic	unipinnate	anastomosing	round, indusiate
13.	<i>T. fuscipes</i>	monomorphic to slightly dimorphic	bipinnatifid to bipinnate at base, bipinnatifid upwards	all free or partly anastomosing	round, indusiate
14.	<i>T. griffithii</i>	monomorphic	bipinnate at base and bipinnatifid upwards	anastomosing	round, indusiate

No.	Species	Frond	Lamina	Venation	Sori shape
15.	<i>T. gymnosora</i>	monomorphic	unipinnate	anastomosing	round, exindusiate
16.	<i>T. hennipmanii</i>	slightly dimorphic	bipinnatifid	partly anastomosing in sterile fronds, all free in fertile fronds	round, indusiate
17.	<i>T. herpetocaulos</i>	monomorphic or slightly dimorphic	unipinnate	anastomosing	round, indusiate
18.	<i>T. hymenophylla</i>	monomorphic	tripinnatifid at base, bipinnatifid upwards	all free	round, indusiate
19.	<i>T. impressa</i>	dimorphic	bipinnatifid to bipinnate at base, bipinnatifid upwards	anastomosing	round, indusiate
20.	<i>T. keckii</i>	monomorphic	bipinnatifid to bipinnate at base, bipinnatifid upwards	anastomosing	round, indusiate
21.	<i>T. kehdingiana</i>	dimorphic	simple, entire	anastomosing	round, indusiate
22.	<i>T. laotica</i>	monomorphic	bipinnatifid or bipinnate at base, unipinnate to bipinnatifid upwards	anastomosing	round, indusiate
23.	<i>T. manilensis</i>	monomorphic	tripinnatifid to tripinnate at base, bipinnatifid to bipinnate upwards	all free	round, indusiate
24.	<i>T. melanocaula</i>	monomorphic	bipinnatifid	anastomosing	round, indusiate

No.	Species	Frond	Lamina	Venation	Sori shape
25.	<i>T. multicaudata</i>	monomorphic	bipinnate or tripinnate at base, bipinnatifid or bipinnate upwards	partly anastomosing	round, indusiate
26.	<i>T. nayarii</i>	dimorphic	bipinnatifid	partly anastomosing	acrostichoid
27.	<i>T. phaeocaulis</i>	monomorphic	bipinnate at base, bipinnatifid upwards	anastomosing	round, indusiate
28.	<i>T. phanomensis</i>	monomorphic	bipinnatifid to bipinnate at base, bipinnatifid upwards	partly anastomosing	round, exindusiate
29.	<i>T. poilanei</i>	monomorphic	unipinnate	anastomosing	round, indusiate
30.	<i>T. polymorpha</i>	monomorphic	unipinnate	anastomosing	round, indusiate
31.	<i>T. remotipinna</i>	monomorphic	tripinnate to quadripinnatifid at base, bipinnatifid to tripinnatifid upwards	anastomosing	round, indusiate
32.	<i>T. rockii</i>	monomorphic	bipinnatifid to quadripinnatifid at base and bipinnatifid to tripinnatifid upwards	anastomosing	round, indusiate
33.	<i>T. sagenioides</i>	monomorphic	bipinnatifid	all free	round, indusiate

No.	Species	Fronde	Lamina	Venation	Sori shape
34.	<i>T. semipinnata</i>	dimorphic	unipinnate	anastomosing	elongate, exindusiate
35.	<i>T. siifolia</i>	dimorphic	trifoliate to quinquefoliate	anastomosing	round, indusiate
36.	<i>T. simonsii</i>	monomorphic	bipinnatifid to bipinnate at base and unipinnate to bipinnate upwards	anastomosing	round, exindusiate
37.	<i>T. singaporiana</i>	monomorphic to slightly dimorphic	generally simple, entire	anastomosing	round, indusiate
38.	<i>T. stenosemioides</i>	dimorphic	bipinnatifid	partly anastomosing	round, indusiate, sometimes coenosori
39.	<i>T. subpedata</i>	monomorphic	simple, trilobed	anastomosing	round, indusiate
40.	<i>T. subvariolosa</i>	dimorphic	bipinnatifid, sometimes bipinnate at base	anastomosing	round, indusiate
41.	<i>T. tenerifrons</i>	monomorphic	bipinnatifid to bipinnate at base, bipinnatifid upwards	partly anastomosing	round, exindusiate
42.	<i>T. trichotoma</i>	monomorphic	bipinnate at base, bipinnatifid upwards	all frees	round, indusiate
43.	<i>T. vasta</i>	monomorphic	simple, pinnatifid	anastomosing	round, indusiate
44.	<i>T. zeilanica</i>	dimorphic	trifoliate, rarely quinquefoliate	anastomosing	acrostichoid
45.	<i>T. zippelii</i>	monomorphic	bipinnatifid	all frees	n/a
46.	<i>T. sp.1</i>	monomorphic	bipinnatifid	partly anastomosing	round, indusiate
47.	<i>T. sp.2</i>	slightly dimorphic	bipinnate at base, bipinnatifid upwards	anastomosing	round, exindusiate



No.	Species	Fronde	Lamina	Venation	Sori shape
48.	<i>T. sp.3</i>	slightly dimorphic	tripinnatifid at base, bipinnatifid upwards	partly anastomosing in sterile fronds, all free in fertile fronds	round, indusiate
49.	<i>T. sp.4</i>	slightly dimorphic	bipinnatifid	partly anastomosing	elongate only at sinuses near margin and margin reflexed; exindusiate
50.	<i>T. sp.5</i>	monomorphic	bipinnate at base, bipinnatifid upwards	partly anastomosing	n/a
51.	<i>T. sp.6</i>	monomorphic	bipinnate	anastomosing	round, indusiate
52.	<i>T. sp.7</i>	monomorphic	bipinnate at base, bipinnatifid upwards	anastomosing	round, indusiate
53.	<i>T.sp.8</i>	slightly dimorphic	simple, entire	anastomosing	elongate, exindusiate
54.	<i>T. sp.9</i>	slightly dimorphic	bipinnate at base, bipinnatifid upwards	anastomosing	round, indusiate

## 5.2 Variations within the *Tectaria*

Re-examination on Thai *Tectaria* specimens from main herbaria in Europe and some Asian countries together with some additional specimens from fieldworks showed some common gross morphology in the *Tectaria*. It has, therefore, long been doubted and likely to be incorrectly named among some herbaria collections. According to Ding et al. (2014) on phylogenetic study of the fern genus *Tectaria* (Tectariaceae) in the Old World inferred from cpDNA sequences, the wider circumscription boundary of the *Tectaria* has been affirmed. At present, it is difficult to define the diagnostic characters of this genus. Thus, this study was dedicated on some comparative characteristics among dubious species as well as in some species complex for easily and accurately understanding. Above all, venation patterns, arrays of sori distribution, frond shapes, lamina-surface characters, together with characters of scale are the most important characters for species delimitation.

### 5.2.1 *Tectaria singaporiana* and related species

Among 54 species of the Thai *Tectaria*, *T. singaporiana*, *T. kehdingiana*, and *T. sp.8* are the only three species having simple entire lamina. However, their differences in characters of fertile fronds, venation, sori and indusia are easy to distinguish the species (Table 5.2). They occur in shaded area on mountain slopes near streams in evergreen forest at low altitude. It is interesting to note that they are found only in peninsular Thailand.

### 5.2.2 *Tectaria decurrens* and related species

*Tectaria decurrens*, *T. fauriei*, *T. vasta* and *T. gymnosora* are species having pinnatifid lamina in common. They differed in winged stipe, the presence of proliferous bulbils, sori, and indusia (Table 5.3). It is also worth noting that *T. gymnosora* was synonymized with *T. fauriei* by Holttum (1986a), but it was treated here as a good species. It can be separated from *T. fauriei* by lacking winged stipe and indusia, and-sori distribution only at junction of anastomosing veins. They grew in the same ecological habitat of shaded area on mountain slopes near stream in evergreen forest but differing in altitudinal gradient and distribution range. *T. decurrens* has a widespread distribution throughout Thailand at 100–850 m alt. *T. fauriei* mainly occurs in northern Thailand at 200–1,300 m alt. Interestingly, a collected specimen of this species from Narathiwat province, peninsular Thailand was found along with specimens collected from Pahang, peninsular Malaysia. Regarding to *T. vasta* was previously found mainly in peninsular Thailand at near sea level to 830 m alt. This study found a specimen collected from Ban Bueng district, Chonburi province and specimens collected from Mae Sai subdistrict, Rong Kwang district, Phrae province. *T. vasta* has a worldwide distribution from NE India (Assam), Bangladesh, South China towards Malesia. The distribution of *T. decurrens* is from India subcontinent, East Asia, Southeast Asia towards Pacific Islands. Interestingly, this study found specimens of *T. gymnosora* from Vietnam (*Schmid* VN 253, and *Schmid* s.n.) deposited at P. As a result, *T. gymnosora* is no longer an endemic species of Thailand as was reported in the Flora of Thailand (Tagawa and Iwatsuki, 1988).

Table 5.2 Character comparison of *T. kehdingiana* and related species

Characters	<i>T. kehdingiana</i>	<i>T. singaporiana</i>	<i>T. sp.8</i>
Scale			
-color	bicolored, shining brown with paler margin	concolorous, dark brown	concolorous, dark brown
-shape	lanceolate	lanceolate	linear-lanceolate
-margin	hairy	hairy, hairs short filamentous	hairy, hairs long filamentous
Frond	dimorphic	monomorphic or sometimes slightly dimorphic	slightly dimorphic
Lamina			
-shape	elliptic-oblong	broadly lanceolate-elliptic	elliptic-oblong
-apex	acute	acuminate	acuminate
-base	cuneate	cuneate to attenuate,	acute to slightly cuneate
-margin	entire	sometimes acute entire	entire
Costal areoles	bearing branched included veinlets in sterile fronds and free veinlets in fertile fronds	bearing branched veinlets	bearing a few simple veinlets
Sori (position)	terminal on included veinlets, one in each areoles, covered throughout abaxially, rather deeply impressed.	on anastomosing veins, in 4–5 rows between main veins	usually confluent, elongate on anastomosing veins, or sometimes round, in 3–4 rows between main veins
Indusia	round-reniform, peltate, persistent	round-reniform, peltate, caducous	exindusiate

### 5.2.3 *Tectaria angulata* and related species

The members in this group compose of *T. angulata*, *T. crenata*, *T. fissa*, *T. herpetocaulos*, *T. poilanei*, *T. polymorpha*, and *T. siifolia*, they have unipinnate frond with entire pinnae in common. They can be divided into two groups by using sori position. Sori of *T. angulata* and *T. crenata* locate on terminal veinlets in areoles, whereas the sori of the other species place on anastomosing veins. However, they can further classify based on the other characters, e.g. rhizome, proliferous bulbils, pinnae shape (Tables 5.4 & 5.5). Nevertheless, they grow in similar ecological condition in shaded areas on mountain slopes near stream banks in evergreen forest but differing

in altitudinal levels. *T. angulata*, *T. crenata*, *T. fissa*, and *T. siifolia* are mostly found at low altitude in peninsular Thailand. *T. herpetocaulos* and *T. polymorpha* are distributed throughout Thailand at altitude ranging from 100 to 1,300 m. *T. poilanei* was found in northern and south-eastern Thailand at altitude above 1,000 m. This is the first report of *T. poilanei* in Thailand and the second report of the wider distribution outside Vietnam.

#### 5.2.4 *Tectaria acrocarpa* and related species

Some fern species have fully free veins or partly free veins with costal and costular areoles and bearing fronds with elliptic-oblong in outline. They were previously placed in the genus *Ctenitopsis* Ching ex Tardieu & C. Chr. (Ching and Wang, 1983; Tardieu and Christensen, 1941; Tsai and Shieh, 1994). Furthermore, species with shortened basal basispic lobes were transferred to the genus *Heterogonium* (Copeland, 1947; Holttum, 1954, 1991b; Tagawa and Iwatsuki, 1988). At present, based on molecular analysis by (Ding et al., 2014), *Heterogonium* was merged into *Tectaria* (Christenhusz, 2010; Dong, 2014; Mazumdar, 2014). This complex composed of *T. acrocarpa*, *T. fuscipes*, *T. hennipmanii*, *T. sagenioides*, *T. trichotoma*, and *T. zippelii*. These taxa can be placed into two groups based on their basal basispic lobes. Three species, i.e. *T. hennipmanii*, *T. sagenioides*, and *T. zippelii*, have short basispic lobes at basal pinnae and the other three species have long basispic lobes at basal pinnae. Their different characters were listed in Tables 5.6 & 5.7. These six species usually grow on moist slope in shady places in evergreen forest. *T. acrocarpa* is reported here as a new record, it was found at 1,300 m of Doi Phu Kha National Park, Nan province. This is a wider distribution of this species outside south China. *T. fuscipes* was mainly distributed in northern through south-western Thailand at 150–1,525 m alt. *T. hennipmanii* is an endemic species. Only two incomplete specimens were found at Doi Muser Horticultural Experimental Station, Tak province, and Doi Phu Kha National Park, Nan province at 800–1,300 m alt. Regarding to *T. sagenioides*, it is a widespread species throughout Thailand, found from near sea level to 1,600 m alt. *T. trichotoma* and *T. zippelii* are new records of Thailand. *T. trichotoma* is a terrestrial fern in primary evergreen forest. It was found at 560 m alt. in Kaeng Krachan National Park, Kaeng Krachan district, Phetchaburi province. *T. zippelii* grows in semi-shade and on damp ground in evergreen forest at 250–600 m alt. at Khao Nan National Park, Nakhon Si Thammarat province.

Table 5.3 Character comparison of *T. decurrens* and related species

Characters	<i>T. decurrens</i>	<i>T. fauriei</i>	<i>T. gymnosora</i>	<i>T. vasta</i>
Stipe	winged equally from base, 1.0–2.2 cm wide	winged in upper half or narrowly nearly to base, becoming narrower towards base, 0.3–0.6 cm wide	no wing	winged equally nearly to base, 1.5–3.5 cm wide
Rachis	winged	winged	winged	winged
Lamina	pinnatifid	pinnatifid	unipinnate	pinnatifid
Proliferous bulbils	absent	present	absent	absent
Sori (position)	terminal on free included veinlets, in 2 rows between main veins, deeply impressed	terminal on free included veinlets or dorsal on anastomosing veins, in 2–5 irregular rows between veins	on junction of anastomosing veins or coupling veinlets, in 2–3 irregular rows between veins	mostly dorsal on anastomosing veins and somewhat terminal on included veinlets
Indusia	round-reniform, peltate, persistent	round-reniform, caducous	exindusiate	round-reniform, peltate, persistent

Table 5.4 Character comparison of *T. angulata* and *T. crenata*

Characters	<i>T. angulata</i>	<i>T. crenata</i>
Lateral pinnae		
-pair	1–2	3–10
-size	10.0–20.0 × 2.5–7.0 cm	16.0–35.0 × 2.0–7.0 cm
-shape	ovate or elliptic-oblong	elliptic-oblong
-margin	entire	entire
Proliferous bulbils	present	absent
Sori		
-size	small	large
-position	terminal on free included veinlets in areoles, more than one in each areoles, scattered throughout	terminal on free included veinlets in areoles, one in each areoles, in two rows between main veins



Table 5.5 Character comparison of *T. fissa* and related species

Characters	<i>T. fissa</i>	<i>T. herpetocaulos</i>	<i>T. poilanei</i>	<i>T. polymorpha</i>	<i>T. siifolia</i>
Rhizome	erect	creeping	erect	erect to ascending	erect to ascending
Fronde	monomorphic	monomorphic to slightly dimorphic	monomorphic	monomorphic	dimorphic
Lamina	unipinnate	unipinnate	unipinnate	unipinnate	trifoliolate to quinquefoliate
Lamina surface	glabrous	glabrous	glabrous	pubescent	glabrous
Lateral pinnae					
-pair	2–4	2–4	2–3	2–3	1
-size	10.0–27.0 × 1.5–3.5 cm	12.5–30.0 × 2.5–7.5 cm	10.0–17.0 × 2.5–4.5 cm	20.0–25.0 × 5.0–8.0 cm	13.5–15.0 × 5.0–6.5 cm in sterile fronds and 4.0–4.5 × 1.5–2.5 cm in fertile fronds
-shape	lanceolate	elliptic-oblong	elliptic-oblong	elliptic-oblong	elliptic
-base	narrowly cuneate	round to oblique	acute	round to oblique	acute
Sori -position	on anastomosing veins, in 2–4 irregular rows between main veins	on anastomosing veins, in 2–6 irregular rows between main veins	on anastomosing veins or couling veinlets, in 2 zig-zag rows between main veins	on anastomosing veins, in 2–4 irregular rows between main veins	on cross veins, in 2 rows between main veins

### 5.2.5 *Tectaria devexa* and related species

Some *Tectaria* species grow well on limestone rocks, i.e. *T. hymenophylla*, *T. impressa*, *T. keckii*, *T. manilensis*, *T. nayarii*, *T. phanomensis*, *T. rockii*, *T. simonsii*, *T. stenosemioides*, *T. sp.1*, *T. sp.3*, *T. sp.4*, *T. sp.7*, and *T. sp.9*. Some of them are restricted on limestone bedrocks, i.e. *T. devexa*, *T. hymenophylla*, *T. manilensis*, *T. phanomensis*, *T. tenerifrons*, and *T. sp.3*. These six species have ovate-subdeltoid laminae in outline. They can be divided into two groups using frond texture, i.e. herbaceous lamina: *T. hymenophylla*, *T. manilensis*, and *T. tenerifrons* and chartaceous lamina: *T. devexa*, *T. phanomensis*, and *T. sp.3*. They also differ in lamina surface, venation pattern, sori, indusia, and spore (Tables 5.8 & 5.9). Interestingly, a specimen from Khao Chong, Trang province, *T. sp.5* has some similarities with *T. devexa* but differing in scale and lamina surface (Table 5.9). It should be proposed as new species of Thailand. Unfortunately, the specimen of this taxon is incomplete and need further collections. *T. devexa* and *T. manilensis* are two common species found

in shady places in limestone areas at low to medium altitude throughout Thailand. In contrast, *T. tenerifrons* has narrow distribution from the north downwards to south-western Thailand, though it has the same ecological habitat as *T. devexa* and *T. manilensis*. In this study, another new record of Thailand, *T. hymenophylla* was found from Thung Kang Yang Hill, Kanchanaburi province. This is the wider distribution outside Myanmar. A calciphyte, *T. phanomensis* is an endemic species, found only on limestone cliffs in evergreen forest at 100–200 m alt in Khlong Phanom National Park, Phanom district, Surat Thani province. Indeed, from additional fieldworks, specimens from Khao Chakan district, Sa Kaeo province, *T. sp.4* [*T. Boonkerd et al.* 2011-416 (BCU)] did not matched with any known species and should be proposed as new species. However, these newly discovered fern species shows once again that additional fieldworks in Thailand are needed.



Table 5.6 Character comparison of *T. acrocarpa* and related species

Characters	<i>T. acrocarpa</i>	<i>T. fuscipes</i>	<i>T. trichotoma</i>
Scale color	bicolored, castaneous with paler margin	bicolored, dark brown with paler margin	bicolored, dark brown with paler margin
Frond	slightly dimorphic	monomorphic to slightly dimorphic	monomorphic
Lamina surface	glabrous	pubescent	glabrous
Lateral pinnae			
-pair	6–8	up to 10	8
-size	11.5–20.0 × 2.0–2.5 cm in sterile fronds and 8.5–13.0 × 1.5–2.0 cm in fertile fronds	4.0–14.0 × 1.0–4.0 cm	9.5–17.0 × 2.0–5.5 cm
-shape	linear-lanceolate	oblong-lanceolate	lanceolate
Venation pattern	fully free veins	fully free veins or partly anastomosing	fully free veins
Sori (position)	terminal on veinlets at apical lobes, in 2 rows between main veins	terminal on free veins, in 2 rows between main veins	terminal on short acroscopic branches of veinlets and sometimes dorsal on veinlets, in 2 rows between main veins
Spore	perispore without spines	perispore with spines	n/a

#### 5.2.6 *Tectaria coadunata* and *T. remotipinna*

These two species, i.e. *T. coadunata* and *T. remotipinna* were confused as the same species for a long time. They are different in some characters, especially spines on rhizome and stipe base (Table 5.10). *T. coadunata* has wide distribution from India, Nepal, Bhutan, China, SE Asia and Malesiana, while *T. remotipinna* confined to Bhutan and South China. *T. remotipinna* is previously published as a new record for Thailand (Lindsay et al. 2013). Moreover, based on Thai specimens, Mae Wong National Park is the southernmost locality of *T. remotipinna*.

Table 5.7 Character comparison of *T. hennipmanii* and related species

Characters	<i>T. hennipmanii</i>	<i>T. sagenioides</i>	<i>T. zippelii</i>
Scale color	concolorous, pale brown to light brown	bicolored, dark brown with ferruginous margin	concolorous, dark brown
Frond	slightly dimorphic	monomorphic	monomorphic
Stipe	castaneous to dull brown	deep castaneous to nearly black	stramineous to pale brown
Lamina			
-texture	chartaceous	herbaceous to chartaceous	herbaceous
-surface	glabrous except few short hairs on midrib and main veins	pubescent, covering with unicellular brown hairs on lamina and 3-celled brown hairs on rachis, costae, main veins, and margin of lamina	pubescent, covering with filiform white hairs on main veins and lateral veins, densely on rachis, costae, and margin of lamina
Venation pattern	partly anastomosing forming costal and costular areoles without free included veinlets in sterile fronds, fully free veins in fertile fronds	fully free veins	fully free veins
Sori	terminal on short acroscopic branch of veinlets, in 2 rows between main veins	terminal on short acroscopic branch of veinlets, in 2 rows between main veins	n/a

Table 5.8 Character comparison of *T. hymenophylla* and related species

Characters	<i>T. hymenophylla</i>	<i>T. manilensis</i>	<i>T. tenerifrons</i>
Lamina	tripinnatifid	tripinnatifid to tripinnate	bipinnatifid
Lamina surface	pubescent, very few thick hairs between veins on upper surface present, densely hairy on costae, costules and midrib	pubescent, many thick hairs between veins on upper surface present, densely hairy on costae, costules and midrib	pubescent, very few thick hairs between veins on upper surface present, densely hairy on costae, costules and midrib
Lateral pinnae	lanceolate-oblong, margin usually lobed	lanceolate-oblong, margin usually lobed	lanceolate, margin dentate
Venation pattern	fully free veins	fully free veins	partly anastomosing forming areoles without free included veinlets, veins near margin usually free, forked
Sori -position	terminal on veinlets, usually near apices of lobes	terminal and dorsal on short acroscopic branches of veinlets	on junction of anastomosing veins or on coupling veinlets
Indusia	round-reniform, thin	round-reniform, thin, caduceus	exindusiate
Spore	n/a	spheroidal, perispore thick	spheroidal with irregular edge, perispore thin



Table 5.9 Character comparison of *T. devexa* and related species

Characters	<i>T. devexa</i>	<i>T. phanomensis</i>	<i>T. sp.3</i>	<i>T. sp.5</i>
Scale color	concolorous, castaneous to dark brown,	concolorous, pale castaneous,	concolorous, dark brown to castaneous,	bicolored, dark brown with narrowly paler margin, monomorphic
Fronde	monomorphic	monomorphic	slightly dimorphic	
Lamina surface	pubescent, covering with short white hairs throughout, densely hairy on costae, costules and midrib	glabrous on both lamina surfaces except densely short hairs on midrib or main veins beneath	pubescent with short brown hairs scattered throughout, densely hairy on costae, costules and midrib	glabrous on both surfaces except few short hairs on sinus, midrib and main veins
Lateral pinnae	3–4	3–6	3	1–2
-pair				
-shape	lanceolate-falcate	lanceolate	lanceolate-elliptic	lanceolate to elliptic-oblong
Venation pattern	partly anastomosing forming costal and costular areoles without free included veinlets, otherwise free, forked	fully free veins or mostly partly anastomosing forming costal areoles without free included veinlets, otherwise free, forked	partly anastomosing forming only costal areoles, otherwise free, forked, all free in fertile fronds	partly anastomosing forming costal and costular areoles without free included veinlets, otherwise free, forked
Sori (position)	terminal on free veins	usually dorsal on free veins and sometimes terminal on free veins	terminal on free veins, sometimes confined near margin	n/a
Indusia	round-reniform, persistent	exindusiate	round-reniform, persistent	n/a

### 5.2.7 *Tectaria griffithii* and related species

In Thailand, there are three species in this complex, i.e. *T. griffithii*, *T. multicaudata*, and *T. sp.2*. According to Ding et al. (2013), *T. multicaudata* is a distinct species from *T. griffithii* based on their difference in venation pattern. They are similar in appearance but differing in their venation pattern, sori, and indusia (Table 5.11). They are found in the same ecological habitat of moist and shaded area on mountain slopes near stream banks in evergreen forest. This study updated distribution in Thailand of these species as well as their determination. *T. griffithii* is confined to northern and south-western Thailand, since only four collections were found. *T. multicaudata* has more wider distribution in 40–900 m alt. from north-eastern Thailand downwards to peninsular Thailand. It is worth noting that a specimen from Kaeng Krachan National Park is similar to *T. multicaudata* in appearance but differing in its venation pattern and sori position on anastomosing veins and exindusiate. It is proposed here as a potential new species. Interestingly, all the three species were found at Kaeng Krachan National Park. Supplementary specimen collections may be in part clarify possible relationship of *T. griffithii* and its closely related species.

Table 5.10 Character comparison of *T. coadunata* and *T. remotipinna*

Characters	<i>T. coadunata</i>	<i>T. remotipinna</i>
Rhizome	erect, ascending to creeping	erect to ascending, a rosette of scales at apex
Lamina	bipinnatifid to bipinnate at base, bipinnatifid upwards	tripinnate to quadripinnatifid at base, bipinnatifid to tripinnatifid upwards
Venation pattern	anastomosing forming areoles with or without free included veinlets, veinlets free, simple	anastomosing forming areoles with free included veinlets, veinlets free, simple
Sori	terminal on free included veinlets, one in each areoles, in two rows between main veins	terminal on free included veinlets, in two irregular rows between adjacent main veins in each lobe, slightly sunken

Table 5.11 Character comparison of *T. griffithii* and relative species

Characters	<i>T. griffithii</i>	<i>T. multicaudata</i>	<i>T. sp.2</i>
Fronde	monomorphic	monomorphic	slightly dimorphic
Venation pattern	fully anastomosing forming irregular areoles with free included veinlets, veinlets free, usually forked	partly anastomosing to form areoles with included free veinlets, veinlets free, simple	partly anastomosing forming many areoles mostly on costae and costules, areoles without free included veinlet, otherwise free, simple
Costal and costular areoles	with free included veinlets, veinlets branched	without free included veinlets	without free included veinlets
Sori	terminal on free included veinlets	terminal on free included veinlets	dorsal on anastomosing veins and on branches of free veins near apices of pinna-lobes, scattered throughout
Indusia	indusiate	indusiate	exindusiate

#### 5.2.8 *Tectaria keckii* and related species

Up to now, *T. keckii* and *T. melanocaula* are rare species, occurring only in peninsular Thailand. They are similar in appearance, although some morphological characters and ecological habitats are different. Their differences in morphology are listed in Table 5.12. *T. keckii* is a calciphyte, whereas *T. melanocaula* grow in moist soil at low altitude in dense evergreen forest. Only two collections of *T. keckii* were discovered, i.e. Bukit Tapang, Pattani province, and Banang Sata district, Yala province. Likewise, only two specimens of *T. melanocaula* were collected from Si Khid Waterfalls National Park, Nakhon Si Thammarat province, and Bannang Sata district, Yala province. However, further field studies are needed.

Table 5.12 Character comparison of *T. keckii* and *T. melanocaula*

Characters	<i>T. keckii</i>	<i>T. melanocaula</i>
Stipe	castaneous to dark brown	deep purplish to nearly black
Lamina	bipinnatifid to bipinnate at base, bipinnatifid upwards	bipinnatifid
Sori	dorsal on anastomosing veins, in two rows between lateral veins	terminal on free included veinlets, in two rows between main veins or scattered throughout abaxially

#### 5.2.9 *Tectaria rockii* and related species

*T. rockii* and *T. simonsii* are difficult to distinguish, especially in the field. They differ in their stipe, terminal pinna, sori, and indusia (Table 5.13). They usually grow in moist and shady mountain slopes near stream banks in evergreen forest. *T. rockii* usually occurs at low altitude in northern to south-western Thailand, while *T. simonsii* is distributed at medium altitude from northern to peninsular Thailand. Both of them can be found on limestone rocks.

#### 5.2.10 *Tectaria impressa* and related species

Another species complex, consists of *T. impressa*, *T. brachiata*, *T. chattagramica*, *T. subvariolosa*, *T. sp.7*, and *T. sp.9*. Formerly, species delimitation in this Thai *Tectaria* has been controversial. They are similar in appearances, but there are still some differences in their rhizome, scale, frond, venation pattern, and sori (Table 5.14). They usually grow in dry soils in deciduous forest or dry evergreen forest near sea level to 1,200 m alt. *T. impressa* has wide distribution throughout Thailand, while *T. brachiata* occurs only in peninsular Thailand. *T. chattagramica* and *T. subvariolosa* are noted here as two new records for Thailand. Two localities of *T. chattagramica* in Thailand, i.e. Huey Ya, Phitsanulok province, and Thung Kang Yang Hills, Kanchanaburi province were recorded. *T. subvariolosa* in Thailand found only in two sites, i.e. Chiang Dao Wildlife Sanctuary, Chiang Mai province, and Nam Nao National Park, Phetchabun province. Interestingly, three specimens from Nong Hin district, Loei province do not correspond with any known taxa and should be proposed as two potential new species: *T. sp.7*, and *T. sp.9*.

Table 5.13 Character comparison of *T. rockii* and *T. simonsii*

Characters	<i>T. rockii</i>	<i>T. simonsii</i>
Stipe	stramineous to light brown adaxially, deeper brown abaxially	mostly purplish to nearly black, sometimes dark brown
Lamina	bipinnatifid to quadripinnatifid at base and bipinnatifid to tripinnatifid upwards	simple when young, becoming bipinnatifid to bipinnate at base and unipinnate to bipinnate upwards when mature
Lamina size	30.0–80.0 x 22.0–50.0 cm	24.0–55.0 x 22.0–35.0 cm
Lateral pinnae		
-pair	1–2	1–3
-size	13.0–24.0 x 3.5–15.0 cm	13.0–21.0 x 2.5–16.0 cm
-margin	pinnatifid	shallowly lobed
Terminal pinna	pinnatifid	tri-lobed
Venation pattern	anastomosing forming areoles with free included veinlets near costa, otherwise free, forked near margin, veinlets simple or branched	fully anastomosing forming irregular areoles with free included veinlets, veinlets free, simple or forked
Sori	terminal at coupling veinlets near margin or dorsal on anastomosing veins, in irregular rows between adjacent lateral veins, usually confined to lobes	usually on junction of anastomosing veins or on coupling veinlets
Indusia	round-reniform,	exindusiate



Table 5.14 Character comparison of *T. brachiata* and related species

Characters	<i>T. brachiata</i>	<i>T. chattagramica</i>	<i>T. impressa</i>
Rhizome	erect to ascending	erect	creeping or suberect
Scale			
-color	concolorous, dark brown	concolorous, dark brown to castaneous	concolorous, dark brown,
-margin	densely hairy, hairs long filamentous	entire	hairy, hair short filamentous
Lamina size	19.0–32.0 × 12.0–25.0 cm in sterile fronds and 13.0–16.0 × 10.0–12.0 cm in fertile fronds	13.0–25.0 × 14.0–18.0 cm in sterile fronds and 21.0 × 16.0 cm in fertile fronds	35.0–52.0 × 21.0–30.0 cm in sterile fronds and 12.0–13.5 × 8.0–9.0 cm in fertile fronds
Costal and costular areoles	more or less having free included veinlets	without free included veinlets	without free included veinlets
Sori	terminal on free included veinlets, one in each areoles, in 2 rows between main veins, usually sunken	terminal on short acroscopic branches of veinlets and dorsal on connected veins	terminal on free included veinlets, one in each areoles, in 2 rows between main veins, usually sunken
Spore	ellipsoid, perispore thick	n/a	ellipsoid, perispore thin

Table 5.14 (*Continued*) Character comparison of *T. brachiata* and related species

Characters	<i>T. subvariolosa</i>	<i>T. sp.7</i>	<i>T. sp.9</i>
Rhizome	creeping	creeping	ascending to short-creeping
Scale	bicolored, dark brown with paler ferruginous margin	bicolored, dark brown with paler ferruginous margin	bicolored, dark brown with paler ferruginous margin
Frond Lamina	dimorphic	monomorphic	slightly dimorphic
-shape	ovate-subdeltoid	ovate-subtriangular	ovate-elliptic
-size	23.0–30.0 × 18.0–30.0 cm in sterile fronds and 13.0–15.0 × 7.0–10.0 cm in fertile fronds	20.0–28.0 × 20.0–24.5 cm	30.0 × 25.0 cm in sterile fronds and 30.0 × 13.8 cm in fertile fronds
Basal Basiscopic lobes of lateral pinnae	absent	absent	present
Costal and costular areoles	without free included veinlets	without free included veinlets	with free included veinlets
Sori	terminal on free included veinlets and on outer veins of costal and costular areoles, one in each areoles, in 2 rows between main veins, not sunken	terminal on free included veinlets, one in each areoles, in 2 rows between main veins, usually confined near margin, not sunken	terminal on free included veinlets, one in each areoles, in 2 rows between main veins, not sunken
Spore	spheroidal, perispore thin	ellipsoid, perispore with spines	ellipsoid, perispore thick

### 5.3 Typification

According to International Code of Nomenclature (ICN), Melbourne Code Art. 7, 8, and 9. Some *Tectaria* species found in Thailand concur in the ICN rules as described above. Lectotypification should be proposed for the followings: *Aspidium kunstleri* (synonym of *T. barberi*): *Dr. King's Collector* 405 [lectotype (designated here) K! (K000236022), isolectotype K! (K000236021)]; *A. repandum* (synonym of *T. crenata*): *Willdernow* 19734 [lectotype (designated here) B! (B-W-19734-01 1), isolectotype B! (B-W-19734-01 2), photo BM!]; *A. heptaphyllum* (synonym of *T. crenata*): *Horne* 20 [lectotype (designated here) K! (K000598760), isolectotype K! (K000604532)]; *A. persoriferum* (synonym of *T. crenata*): [lectotype (designated here) MICH! (photo seen MICH1190039), photo K! (K000360734, K000360735)]; *Dryomenis phymatodes* (synonym of *T. siifolia*): *Cuming* 4 [lectotype (designated here) K! (K000360762), isolectotypes BM, K! (K000360760, K000360761), L!, MICH! (photo seen MICH1190387), US! (photo seen US00135266, US01100960, US01100961)]; *Dryopteris sagenioides* var. *gurupahensis* (synonym of *T. sagenioides*): *Kaudern* 18 [lectotype (designated here) S! (photo seen S-P-10859), isolectotype BM! (BM001048664), paralectotypes *Kaudern* 17 S! (photo seen S09-42942, S09-42943, S-P-5084)]; *Polypodium involucratum* (synonym of *T. crenata*): *Roxburgh* 333 [lectotype (designated here) BR! (photo seen BR0000006984922), isolectotype BR! (photo seen BR0000006985257), photo BM!]; *P. semipinnatum* (synonym of *T. semipinnata*): *Roxburgh* 2396 [lectotype (designated here) BR! (BR0000006984960), isolectotype BR! (BR0000006985295)]; *Sagenia longicuris* (synonym of *T. simonsii*): *Cavalerie* 268 [lectotype (designated here) P! (P01440053), isolectotype P! (P01440052)]; *T. crenata*: *Née* s.n. [lectotype (designated here) MA! (photo seen MA213020-2); isolectotypes BM! (BM001048597), MA! (photo seen MA213019)]; *T. devexa*: *Zollinger* 2717 [lectotype (designated here) B! (B 20 0030298), isolectotype BM!, photo BM!, K! (K000237040), P! (photo seen P01512523)]; *T. griffithii*: *Griffith* s.n. [lectotype (designated here) K! (K001080693), isolectotype K! (K001080694)]; *T. griffithii* var. *singaporeana* (synonym of *T. multicaudata*): *C.G. Matthew* s.n. [lectotype (designated here) K! (K000236221), isolectotypes K! (K000236220, K000236222)]; *T. laciniata* (synonym of *T. phaeocaulis*): *C.G. Matthew* s.n. [lectotype (designated here) K! (K001080729), isolectotype K! (K001080730)]; *T. polymorpha*: *Wallich* 382 [lectotype (designated here) E! (E00499054), isolectotypes B! (B 20 0168323), BM! (BM000543775, BM000543776, BM000543778), BR! (BR0000013306236), E! (E00499053, E00499055, E00499056), K!, PH! (PH00004809), US! (US00135268)]; and *T. vasta*: *Blume* s.n. [lectotype (designated here) L! (L 0052210), paralectotype *Blume* s.n. L! (L 0063131), P! (P01437196)].

For decades, Holttum (1991b) noted that type specimen of *T. keckii* was not found and may have been destroyed. The original material of *T. keckii* deposited at B [*F. Kehding* 2817 (B 20 0166122)] was found during specimen studies at main herbaria in Europe. It should be cited as holotype of this species although this type specimen is incomplete, consisting in a line drawing and a small piece of original material. Epitypification of this species is required.

#### 5.4 Distribution, biogeography, ecological habitat, and conservation assessment of Thai *Tectaria*

*Tectaria* is the genus of terrestrial or epipetric ferns which usually grows in moist and shady area on mountain slopes in evergreen forest and sometimes occurs in dry habitat of deciduous forest. The altitude of Thai *Tectaria* are ranging from near sea level to 1,900 m. Some of them, i.e. *T. devexa*, *T. hymenophylla*, *T. manilensis*, *T. phanomensis*, and *T. tenerifrons*, are calciphytes. Thailand is one of the global hotspots of biodiversity known as Indo-Burmese region (Marchase, 2015; Myer et al., 2000). According to Phytogeography of Thailand, the country has been classified into seven floristic regions, northern, north-eastern, eastern, central, south-eastern, south-western, and peninsular. Previously, Thailand floristic region has been a subject of controversy, for example van Welzen et al. (2011). They divided Thailand into four floristic regions: peninsular province (extending in the South-eastern), northern province (with extensions into the south-western and south-eastern), eastern province and the central lowlands, it remains unclear about the boarder of each four regions practically. As a result this study followed Smitinand's system. Distribution of Thai *Tectaria* was listed in Table 5.15. Four species are common species in Thailand, i.e. *T. herpetocaulos*, *T. impressa*, *T. manilensis*, and *T. sagenioides*. Four species, *T. acrocarpa*, *T. coadunata*, *T. hennipmanii*, and *T. remotipinna*, are found only at high elevation more than 800 m alt. in northern Thailand. In addition, eighteen species of *Tectaria* are found only in the peninsula, i.e. *T. angulata*, *T. aurita*, *T. barberi*, *T. brachiata*, *T. fissa*, *T. keckii*, *T. kehdingiana*, *T. melanocaula*, *T. nayarii*, *T. phanomensis*, *T. siifolia*, *T. singaporiana*, *T. stenosemioides*, *T. zippelii*, *T. sp.1*, *T. sp.4*, *T. sp.5*, and *T. sp.8*. Furthermore, *T. crenata* and *T. semipinnata* have extended distribution from peninsular Thailand to some islands of Trat province (Ko Chang, and Ko Khlum), south-eastern Thailand. Likewise, *T. vasta* and *T. decurrens* are common species in the Peninsula and they can be found in mountains in south-eastern and northern Thailand, respectively. However, the distribution of pteridophytes in Thailand is probably influenced by the climatic factors rather than geohistoric and edaphic factors as was pointed out by Iwatsuki (1973a).

According to Holttum (1991b), Southeast Asia was regarded as the center of origin of the genus *Tectaria*. Thailand is considered as a collective center of botanic diversity designated by four floristic regions: Indo-Burmese, Sino-Himalayan, Indo-Chinese, and Malesian elements (Takhtajan, 1986). Regarding to *Tectaria*'s distribution, Thailand is likely to be the meeting point of Asian species. In addition, ten endemic species are found in Thailand.

Three species are members of the Indo-Burmese elements, i.e. *T. chattagramica*, *T. hymenophylla*, and *T. tenerifrons*. *T. chattagramica* has rather wide distribution from NE India downwards to northern and south-western Thailand while *T. hymenophylla*, and *T. tenerifrons* has restricted distribution only in Myanmar and Thailand. This study indicates that Thailand is the easternmost station of these three species. Four species are Indo-Chinese elements, i.e. *T. gymnosora*, *T. laotica*, *T. poilanei*, and *T. subvariolosa*. The distribution at Doi Chong, Mae Hong Son province is the northernmost and westernmost station of *T. poilanei*. Likewise, Chiang Dao Wildlife Sanctuary, Chiang Mai province is the westernmost station of *T. subvariolosa*.

Most pteridophytes in northern and north-eastern Thailand are from Sino-Himalayan region. They are distributed in Himalayan mountains, extending eastwards to SW China, N Myanmar, N Thailand, N Indochina, and sometimes through Taiwan and southern edge of Japan (the Ryukyu Islands) (Iwatsuki, 1973a). Likewise, four *Tectaria* species are members of Sino-Himalayan elements: *T. acrocarpa*, *T. coadunata*, *T. remotipinna*, and *T. subpedata*. In these taxa, *T. acrocarpa* and *T. remotipinna* has the narrow distribution at high elevation only in south China and northern Thailand, while *T. coadunata* has an extending distribution from northwest India through northern Thailand. As for *T. subpedata*, it distributes from Taiwan to Vietnam and north-eastern Thailand at Man Daeng Waterfalls, Phu Hin Rong Kla National Park, Dan Sai district, Loei province. This place is the westernmost station of this species.

Twelve Malesian elements are found in peninsular Thailand, i.e. *T. angulata*, *T. aurita*, *T. brachiata*, *T. crenata*, *T. fissa*, *T. keckii*, *T. kehdingiana*, *T. nayarii*, *T. siifolia*, *T. singaporiana*, *T. stenosemioides*, and *T. zippelii*. They are widespread from the Kra Isthmus downward to peninsular Malaysia and Malay Archipelago. As of now, the northernmost station of *T. singaporiana* is at Bandon, Surat Thani province; meanwhile, Klong Klai Park Ranger Unit, Khao Nan National Park, Nakhon Si Thammarat province is the northernmost station of *T. kehdingiana*. Interestingly, the present distribution pattern of *T. kehdingiana* may be related to the theory of continental drift. According to this theory, Sumatra Island was formerly unified into peninsular Thailand and peninsular Malaysia, but it is now the western part of the Indochina subcontinent (Metcalf, 1988). In case of *T. kehdingiana*, a small population of less than 20 mature individuals was observed at Wang Kelian Heritage Trails, northern peninsular Malaysia (Rusea et al., 2004). This species is regarded as a very rare species on Nicobar Islands (Chandra et al., 2008; Fraser-Jenkins, 2012). In Thailand, approximately 50 mature individuals were found in Khao Luang and Khao Nan National Parks, Nakhon Si Thammarat province. So far, 5 natural habitats are known; no information about the status of the population on Sumatra and Mentawai Islands is available (Iwatsuki, 1973b). Since less than 250 mature individuals from the presently known natural sites were observed, this species should be listed as an endangered species on a worldwide basis (IUCN, 2012). In addition, the new locality of *T. zippelii* at Khao Nan National Park, Nakhon Si Thammarat province, is the northernmost and westernmost station of this fern species.

In case of *T. melanocaula*, Si Khid Waterfall National Park, Nakhon Si Thammarat province, is the northernmost station and its distribution range is from Madagascar towards Polynesia. The distribution of this species in Madagascar (*Boivin* s.n., deposited in L) has resulted in relictual Gondwanan disjunctions as well as continuous dispersal events across the Indian Ocean (Schatz, 1996). In addition, *T. trichotoma* has an extends its distribution from Philippines to Indo-Chinese region in Vietnam and towards to south-western Thailand at Kaeng Krachan National Park, Kaeng Krachan district, Phetchaburi province. This new locality is the westernmost station of this fern species. In addition, *T. manilensis* has the widest distribution in Thailand and extends eastwards to the Philippines.

Eleven endemic species of *Tectaria* include *T. hennipmanii*, *T. phanomensis*, *T. sp.1*, *T. sp.2*, *T. sp.3*, *T. sp.4*, *T. sp.5*, *T. sp.6*, *T. sp.7*, *T. sp.8*, and *T. sp.9*. *T. hennipmanii* was published as a new species of *Heterogonium* from incomplete





No.	Species	Thailand floristic region						
		N	NE	E	C	SE	SW	P
13.	<i>T. fuscipes</i>	✓	✓	✓		✓	✓	
14.	<i>T. griffithii</i>	✓					✓	
15.	<i>T. gymnosora</i>	✓	✓	✓		✓		
16.	<i>T. hennipmanii</i>	✓						
17.	<i>T. herpetocaulos</i>	✓	✓	✓	✓	✓	✓	✓
18.	<i>T. hymenophylla</i>						✓	
19.	<i>T. impressa</i>	✓	✓	✓	✓	✓	✓	✓
20.	<i>T. keckii</i>							✓
21.	<i>T. kehdingiana</i>							✓
22.	<i>T. laotica</i>	✓	✓	✓		✓		
23.	<i>T. manilensis</i>	✓	✓	✓	✓	✓	✓	✓
24.	<i>T. melanocaula</i>							✓
25.	<i>T. multicaudata</i>		✓	✓	✓	✓	✓	✓
26.	<i>T. nayarii</i>							✓
27.	<i>T. phaeocaulis</i>	✓	✓					
28.	<i>T. phanomensis</i>							✓
29.	<i>T. poilanei</i>	✓				✓		
30.	<i>T. polymorpha</i>	✓	✓	✓			✓	✓
31.	<i>T. remotipinna</i>	✓						
32.	<i>T. rockii</i>	✓	✓			✓	✓	✓
33.	<i>T. sagenioides</i>	✓	✓	✓	✓	✓	✓	✓
34.	<i>T. semipinnata</i>					✓		✓
35.	<i>T. siifolia</i>							✓
36.	<i>T. simonsii</i>	✓	✓	✓		✓	✓	✓
37.	<i>T. singaporiana</i>							✓
38.	<i>T. stenosemioides</i>							✓
39.	<i>T. subpedata</i>		✓	✓				
40.	<i>T. subvariolosa</i>	✓	✓					
41.	<i>T. tenerifrons</i>	✓			✓	✓	✓	
42.	<i>T. trichotoma</i>						✓	
43.	<i>T. vasta</i>	✓				✓		✓
44.	<i>T. zeilanica</i>	✓	✓		✓	✓	✓	
45.	<i>T. zippelii</i>							✓
46.	<i>T. sp.1</i>							✓
47.	<i>T. sp.2</i>						✓	
48.	<i>T. sp.3</i>					✓		
49.	<i>T. sp.4</i>							✓
50.	<i>T. sp.5</i>							✓
51.	<i>T. sp.6</i>		✓					
52.	<i>T. sp.7</i>		✓					
53.	<i>T. sp.8</i>							✓
54.	<i>T. sp.9</i>		✓					

## 5.5 Utilization

### 5.5.1 Ornamentation

According to a review on some current literatures and direct observations from some markets and private gardens, some *Tectaria* species are used as ornamental plants. Examples included *T. angulata*, *T. decurrens*, *T. impressa*, *T. nayarii*, *T. polymorpha*, *T. semipinnata*, and *T. zeilanica* (de Winter and Amoroso, 2003). It is noted that these cultivated plants propagate easily by rhizome cutting. Nevertheless, spore propagation and micropropagation by tissue culture should be studied for the development of ornamental pteridophytes. There was a study on selected native pteridophytes in Sri Lanka for floriculture industry. *Tectaria thwaitesii* (Bedd.) Ching, is one of the 38 potential ornamental pteridophytes for using as bed plants and decorative foliage (Ranil et al., 2015). Further study in Thai pteridophytes may be useful for floriculture development.

### 5.5.2 Medicinal plants

Interestingly, some *Tectaria* species such as *T. fauriei*, *T. herpetocaulos*, and *T. impressa*, were recorded as medicinal plants. It was noted that *T. fauriei* could be used for dermatitis treatment by soaking fronds in water, then roasting and rubbing on skin [Fahmdin, interviewed, 13 February 1991, noted on voucher specimen from Chiang Rai, Mae Chan, 625 m, 13 Feb. 1991, J. F. Maxwell, S. Suttajit, W. Pannavalee, and U. Sangsorn 99 (CMU, L)]. In addition, rhizome of *T. herpetocaulos* and *T. impressa* were noted as medicinal plants for the fever remedy by Din [voucher specimen from Loei, Phu Kradueng National Park, Sam Khrae, 800 m, 18 May 1948, Din 3 (BKF)], and Boonkerd (ทิวศักดิ์ บุญเกิด, 2524) respectively. However, laboratory and clinical experiment in these species for medicine purpose should be carefully investigated.

## 5.6 Conclusion

*Tectaria* Cav. is a terrestrial or epipetric fern comprising 150-210 species worldwide, predominantly in the tropics. It is belonged to the family Tectariaceae Panigrahi. Previously, 25 species were enumerated in the Pteridophyte Flora of Thailand. It was found that this genus has a great number of variations in both vegetative and reproductive features. In the last 10 years, some new records, new species and new combinations were added to the Thai Flora. So far, key-to-species and descriptions are not relevant with the morphology of the present known species. This revision studies mainly on re-examination of recently collected specimens and existing herbarium specimens deposited in main world herbaria. In addition, anatomical and palynological studies in some related species were achieved. The updated key-to-species and descriptions were prepared.

Fifty-four species are enumerated, including five Thai species of the previously recognized *Heterogonium* C. Presl and *Quercifilix* Copel. The name of two species, *T. melanocaula* (Blume) Copel., and *T. singaporiana* (Wall. ex Hook. & Grev.) Copel., are amended. The following taxa: *Aspidium kunstleri* (synonym of *T.*

*barberi*), *A. repandum* (synonym of *T. crenata*), *A. heptaphyllum* (synonym of *T. crenata*), *A. persoriferum* (synonym of *T. crenata*), *Dryomenis phymatodes* (synonym of *T. siifolia*), *Dryopteris sagenioides* var. *gurupahensis* (synonym of *T. sagenioides*), *Polypodium involucreatum* (synonym of *T. crenata*), *P. semipinnatum* (synonym of *T. semipinnata*), *Sagenia longicruris* (synonym of *T. simonsii*) *T. burmanica* (synonym of *T. rockii*), *T. crenata*, *T. devexa*, *T. griffithii*, *T. griffithii* var. *singaporeana* (synonym of *T. multicaudata*), *T. laciniata* (synonym of *T. phaeocaulis*), *T. polymorpha*, *T. rockii*, and *T. vasta*, should be lectotypified. Epitypification of *T. keckii* should be chosen.

Eleven species are new records for Thailand, viz. *T. acrocarpa* (Ching) Christenh., *T. aurita* (Sw.) S. Chandra, *T. chattagramica* (C.B. Clarke) Ching, *T. hymenophylla* (Parish ex Bedd.) Holttum, *T. kehdingiana* (Kuhn) M.G. Price, *T. multicaudata* (C.B. Clarke) Ching, *T. poilanei* Tardieu, *T. subpedata* (Harr.) Ching, *T. subvariolosa* S.Y. Dong, *T. trichotoma* (Fée) Tagawa and *T. zippelii* S.Y. Dong.

Moreover, nine new species are being proposed. It is noted that venation patterns, sori distribution, frond shapes, lamina-surface characters, and scale characters are the important characters for species delimitation, contrast to the number and vascular bundle arrangement in stipe. This stipe anatomy is poorly significant in distinguishing the related species, since a number of vascular bundle are varied even in the same stipe of the same species. Likewise, stomatal apparatus is polocytic in almost Thai *Tectaria* species, except copolocytic type in *T. griffithii* and *T. multicaudata*. It implies that this character cannot be used for species delimitation in the Thai *Tectaria*. In contrast to spore characteristics can be used to segregate some related species, especially perispore ornamentation.

### 5.7 Suggestion

This study based on re-examination in morphological, anatomical, and palynological characters in fern genus *Tectaria* in Thailand. Some species are quite similar. I suggest that biosystematics studies among some species complex are needed to clarify their evolutionary relationship and species delimitation. Furthermore, additional fieldworks are needed to fulfill taxonomic information of some species.

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**APPENDIX**



จุฬาลงกรณ์มหาวิทยาลัย  
CHULALONGKORN UNIVERSITY



## VITA

Mr. Sirisak Wongphakdee was born on May 31, 1992, at Siriraj Hospital, Bngkok. He was graduated in Bachelor's Degree of Biology (first class honour) from Department of Biology, Faculty of Science, Chulalongkorn University in 2013. Due to his concentration of plant diversity, especially in pteridophytes, he studied in Master of Science in Botany during 2013-2015.

