THAI FOR. BULL. (BOT.), SPECIAL ISSUE: 143–155. 2009.

An update on the Apocynaceae in Thailand

DAVID J. MIDDLETON[1]

ABSTRACT. Since publication of the Flora of Thailand Apocynaceae account in 1999 there have been developments in our understanding of the relationships within the family, some changes in generic delimitations, new species described and new records found. The current information is synthesised, a new key to genera presented, and keys to the species in altered genera given.

INTRODUCTION

The Apocynaceae *sensu stricto* was published in the *Flora of Thailand* in 1999 (Middleton, 1999). Since its publication there have been further developments in Apocynaceae systematics that have a direct bearing on the Flora account. This paper sets out to clarify what these developments are, a new generic key is provided, and the current situation in those genera directly affected by taxonomic changes is highlighted.

FAMILY CONCEPT

In Middleton (1999) the relationship between Apocynaceae and the Asclepiadaceae, as traditionally delimited, was discussed. It was noted that the Asclepiadaceae was nested within the Apocynaceae in the limited amount of molecular phylogenetic work that had been done to that time. Since then there has been a great deal more molecular phylogenetic work and the relationships between the Apocynaceae and Asclepiadaceae, and between the various subfamilies of each, are becoming clearer (see Simões *et al.*, 2007 and Livshultz *et al*., 2007 for an overview). To summarise, the three subfamilies of the former Asclepiadaceae are each monophyletic and all are nested in subfamily Apocynoideae of the Apocynaceae s.s. It is as yet unresolved whether the former Asclepiadaceae is monophyletic (specifically whether the subfamily Periplocoideae is independently nested within the Apocynoideae or whether it forms a clade with Secamonoideae and Asclepiadoideae, which is nested in Apocynoideae). The Apocynoideae + Periplocoideae + Secamonoideae + Asclepiadoideae (APSA clade – Livshultz *et al*., 2007) is nested in the subfamily Rauvolfioideae. Other analyses have supported these conclusions (Sennblad & Bremer, 1996, 2000; Endress *et al.*, 1996; Sennblad *et al*., 1998; Potgieter & Albert, 2001). Amongst researchers working on Apocynaceae and Asclepiadaceae it is now generally agreed that there is only one family, with the name Apocynaceae taking priority, and classifications of the combined family have been published by Endress & Bruyns (2000) and Endress *et al*. (2007). The account of the Apocynaceae published in

[1] Royal Botanic Garden Edinburgh, 20A Inverleith Row, Edinburgh, EH3 5LR, Scotland, U.K.

the *Flora of Thailand* is, in effect, an account of Apocynaceae, subfamilies Rauvolfioideae and Apocynoideae. The account of the same group for *Flora Malesiana* was given this title (Middleton, 2007a). For merely practical reasons it still tends to be the case that researchers concentrate on one or other of the old families given the estimated large size of the group in the world and the various Asian regions (Table 1).

Table 1– Estimates of the number of genera/number of species in the former Apocynaceae and Asclepiadaceae in the world, in Malesia, in Cambodia, Laos and Vietnam (CLV) and Thailand. Superscript numbers refer to references for the figures in the table: 1. Middleton (2007a); 2. Middleton (2010b); 3. Middleton (1999 and subsequent updates); 4. Meve (2002); 5. *Flora Malesiana* Board internal document listing unpublished families; 6. My estimate; 7. Larsen & Chayamarit (2006).

	World	Malesia	CLV	Thailand
Apocynaceae	161/1740[1]	41/298[1]	36/119[2]	36/118[3]
Asclepiadaceae	231/3400[4]	55/450[5]	41/143[6]	45/150[7]
Total	392/5140	96/748	76/249	81/268

The accounts of the Apocynaceae *sensu stricto*, i.e. Apocynaceae subfamilies Rauvolfioideae and Apocynoideae, have been completed for all of the major Southeast Asian Floras (Middleton, 1999, 2004a, 2007a, 2010a, 2010b) but the accounts of the remaining subfamilies are not yet complete or not yet started. If it is unclear which subfamily a collection is in and, therefore, whether it is covered in these Flora accounts here is a key to the five subfamilies of Apocynaceae.

KEY TO THE SUBFAMILIES OF APOCYNACEAE

(ADAPTED FROM ENDRESS & BRUYNS (2000))

1. Anthers free from style head; corolla lobes most often sinistrorse, sometimes dextrorse; fruit dehiscent or indehiscent, syncarpous or apocarpous, a berry, drupe, follicle, or capsule; seeds simple, or with wings, a ciliate margin or with an aril, without a coma at one end **Rauvolfioideae**
1. Anthers adnate to the style head, sometimes only weakly so; corolla lobes in bud most often dextrorse, sometimes sinistrorse or valvate; fruit dehiscent, a pair of follicles, mostly apocarpous or reduced to one or postgenitally fused; seeds mostly compressed, mostly with a coma at one end, occasionally at both ends, rarely absent
  2. Disk, if present, in a ring around the base of the ovary; anthers 4-locular; pollen shed as monads (in Thailand); style head secretions for pollen transport normally a foamy adhesive or gummy, undifferentiated translators, pollinia absent; seeds without a thin margin **Apocynoideae**
  2. Disk located in alternistaminal troughs on staminal feet or staminal tube; anthers 2–4-locular; pollen shed as tetrads or in pollinia; style head secretions for pollen transport forming differentiated translators with sticky end or consisting of a rigid clip and two flexible arms; seeds often with a thin margin
    3. Anthers 2-locular, pollen enclosed in pollinia covered by waxy outer wall **Asclepiadoideae**
    3. Anthers 4-locular, pollen shed as tetrads or, if in pollinia, then without waxy outer wall
      4. Translators with sticky end which adheres to pollinator for removal; pollen usually shed in tetrads, or occasionally in pollinia, from anthers onto spoon- or cornet-shaped receptacle of translator **Periplocoideae**
      4. Translators with hardened, cliplike corpusculum in which some part of the pollinators body becomes caught or removal; pollen in 4 minute pollinia attached directly or indirectly to the corpusculum **Secamonoideae**

GENERIC CHANGES SINCE 1999

As a result of molecular phylogenetic work and new discoveries the list of genera occuring in Thailand for Apocynaceae, subfamilies Apocynoideae and Rauvolfioideae, is somewhat different to that published in Middleton (1999). As a result of the discoveries of Livshultz *et al*. (2007) the genera *Micrechites* Miq. and *Amphineurion* (A.DC.) Pichon have been resurrected. *Micrechites* was synonymised into *Ichnocarpus* R.Br. in Middleton (1999) following the treatments by Forster (1992) and Middleton (1994). After its resurrection there are two species in Thailand, leaving three species of *Ichnocarpus*. *Aganosma marginata* (Roxb.) G.Don, recognised as such in almost all previous work by all authors, including the revision by Middleton (1996), is now to be recognised as *Amphineurion marginatum* (Roxb.) D.J.Middleton.

Micrechites and *Amphineurion* have now been recognised in Thailand due to advances in our understanding of generic delimitations in Asian Apocynaceae rather than due to discoveries of taxa previously unknown in Thailand. However, in addition, a new species in *Kamettia*, a genus previously unknown in Thailand, has been described (Middleton *et al*., 2006).

Trachelospermum axillare Hook.f., recently recorded for Thailand (Middleton, 2002), would have failed to key out in *Trachelospermum* in Middleton (1999) because no species in the genus with stamens inserted at the base of the corolla tube were previously known from the country.

A new key to the genera of Apocynaceae, subfamilies Apocynoideae and Rauvolfioideae, is necessary and is here presented.

KEY TO THE GENERA OF APOCYNACEAE, SUBFAMILIES APOCYNOIDEAE AND RAUVOLFIOIDEAE, IN THAILAND

1. Herbs, sometimes with a woody base **Catharanthus**
1. Woody shrubs, trees or climbers
  2. Leaves in whorls of three or more, rarely with occasional opposite pairs
    3. Corolla tube yellow, infundibuliform, > 3.5 cm long, anthers without appendages; cultivated; fruit a spiny capsule **Allamanda**
    3. Corolla colour variable, if infundibuliform then anthers with long appendages, < 3 cm long; wild or cultivated
      4. Corolla infundibuliform, sometimes doubled; anthers with long terminal appendages; cultivated; seeds with a coma of hairs at one end **Nerium**
      4. Corolla salverform or rotate; anthers without long terminal appendages; usually wild, occasionally cultivated; seeds with or without a coma of hairs at one end
        5. Climbers
          6. Leaves without domatia in axils; stamens free from the style head; seeds without a coma of hairs
            7. Corolla tube < 10 mm long; ovary densely to partly pubescent; seeds without a wing **Alyxia**
            7. Corolla tube > 10 mm long; ovary glabrous; seeds with a wing **Kamettia**
          6. Leaves usually with domatia in axils; stamens adnate to the style head; seeds with a coma of hairs at one end **Parameria**[1]
        5. Trees or shrubs
          8. Corolla lobes overlapping to the right in bud
            9. Leaves not spathulate; mouth of corolla densely pubescent; fruit of paired, slender follicles **Alstonia**
            9. Leaves spathulate; mouth of corolla glabrous; fruit a drupe, large and fibrous **Ochrosia**

[1] Extremely rare form of *Parameria laevigata* with leaves in whorls.

8. Corolla lobes overlapping to the left in bud
10. Corolla pubescent outside; seeds with a ciliate margin **Alstonia**
10. Corolla glabrous outside; seeds with a ciliate margin, naked or winged
11. Secondary leaf veins parallel and ± straight; seeds with a ciliate margin, naked or winged
12. Corolla tube > 5 mm long; longer than or equal to corolla lobe length; leaves acuminate, sometimes shortly so; seeds with a ciliate margin or simple
13. Ovary syncarpous; seeds simple **Rauvolfia**
13. Ovary of 2 separate carpels; seeds with a ciliate margin **Alstonia**
12. Corolla tube < 3 mm long, much shorter than corolla lobes; leaves mostly rounded; seeds winged **Dyera**
11. Secondary leaf veins arcuate ascending; seeds simple **Rauvolfia**

2. All leaves opposite or spirally arranged
14. Leaves spirally arranged
15. Leaves narrowly oblong, < 1 cm wide; cultivated **Thevetia**
15. Leaves obovate or elliptic, > 2 cm wide; cultivated or wild
16. Succulent shrub; anthers with long bristly appendages; seeds with a coma of hairs at each end; cultivated **Adenium**
16. Small trees; anthers without long bristly appendages; seeds without a coma of hairs; cultivated or wild
17. Anthers free from each other, inserted at base of corolla tube; fruits of paired follicles; seeds winged; generally cultivated **Plumeria**
17. Anthers adnate to each other by acumens, inserted at middle of corolla tube or higher; fruit a drupe; seeds simple; cultivated or wild, usually by water **Cerbera**
14. Leaves opposite
18. Plants spiny **Carissa**
18. Plants not spiny
19. Climbers or scramblers
20. Leaves punctate beneath
21. Flowers 4-merous; 4–7 pairs of secondary veins; fruit not dehiscent **Leuconotis**
21. Flowers 5-merous; 7–43 pairs of secondary veins; fruit dehiscent
22. Stamens free from the style head; corolla glabrous in throat; 11–43 pairs of secondary veins; seeds with a corky aril, no coma **Chilocarpus**
22. Stamens adnate to the style head; corolla villous in throat; 7–13 pairs of secondary veins; seeds with a coma, no corky aril **Anodendron**
20. Leaves not punctate beneath
23. Corolla lobes overlapping to the left in bud
24. Stamens adnate to the style head; domatia usually present in secondary vein axils; seeds with a coma of hairs at one end **Parameria**
24. Stamens free from the style head; domatia absent; seeds without a coma of hairs at one end
25. Ovary of 2 separate carpels united into a common style; fruit a drupe, usually moniliform **Alyxia**
25. Ovary syncarpous; fruit a berry, sometimes woody, never moniliform.
26. Tendrils present; ovary 1-celled; fruit soft and fleshy **Willughbeia**
26. Tendrils absent; ovary 1- or 2-celled; fruit soft and fleshy or with a woody exterior
27. Corona absent; disk present; ovary 1-celled; fruit soft and fleshy **Bousigonia**
27. Corona present; disk absent; ovary 2-celled; fruit with a woody exterior **Melodinus**
23. Corolla lobes overlapping to the right in bud
28. Corona present; corolla lobes often drawn out into long tails; seeds with a deciduous basal coma and an apical beak bearing a coma **Strophanthus**
28. Corona absent; corolla lobes not drawn out into long tails; seeds not as above
29. Stamens exserted from corolla tube
30. Corolla infundibuliform; corolla tube 1.7–12 cm long; carpels connate in fruit **Beaumontia**
30. Corolla salverform, rotate or tube narrow and lobes erect; corolla tube < 1.3 cm long; carpels connate in fruit or not
31. Ovary pubescent; follicles in pairs
32. Style inflated in middle or part way along length, glabrous; disk much longer than ovary; seeds without an apical beak **Pottsia**
32. Style filiform, pubescent; disk about same length as ovary; seeds with an apical beak **Vallaris**

31. Ovary glabrous; follicles in pairs or carpels connate in fruit
33. Anthers only slightly exserted from corolla mouth; anthers subsessile; ovary apocarpous; follicles in pairs **Trachelospermum**
33. Anthers completely exserted from corolla mouth; filaments long, often spiral or strongly bent; ovary syncarpous; carpels connate in fruit **Parsonsia**
29. Stamens not exserted from corolla tube
34. Leaves without a strong intramarginal nerve
35. Ovary pubescent
36. Corolla infundibuliform; carpels connate in fruit **Beaumontia**
36. Corolla salverform, rotate or globose; fruit of paired follicles
37. Sepals longer than corolla tube, > 10 mm long **Aganosma**
37. Sepals shorter than to as long as corolla tube, < 5 mm long
38. Corolla tube > 1 cm long **Epigynum**
38. Corolla tube < 0.5 cm long
39. Stamens not inserted at very base of corolla tube; domatia absent from leaves; seed grains not pubescent
40. Disk lobes free and narrow, never shorter than the ovary; anthers appearing elliptic; secondary veins 4–10 pairs **Ichnocarpus**
40. Disk entire and 5-dentate, shorter than the ovary; anthers narrowly triangular; secondary veins 6–20 pairs **Micrechites**
39. Stamens inserted at the very base of corolla tube; domatia sometimes present on leaves; seed grain pubescent
41. Inflorescence with the appearance of a narrow spike; fruit narrow, torulose **Aganonerion**
41. Inflorescence a panicle; fruit narrow or not, not torulose **Urceola**
35. Ovary glabrous
42. Corolla infundibuliform; follicles rather warty outside **Amalocalyx**
42. Corolla salverform or rotate; follicles not warty outside
43. Sepals much longer than corolla tube **Aganosma**
43. Sepals shorter than to as long as corolla tube
44. Anthers with a tuft of hair at the apex; pedicel twisting in fruit **Sindechites**
44. Anthers without a tuft of hair at the apex; pedicel not twisting in fruit
45. Corolla tube ≥ 1.5 cm long
46. Inflorescence flat topped and umbel-like; sepals free from each other **Epigynum**
46. Inflorescence a panicle; sepals often connate into a tube **Chonemorpha**
45. Corolla tube < 1.3 cm long
47. Sepals connate into a tube **Chonemorpha**
47. Sepals free from each other
48. Disk of 5 separate lobes; seeds without an apical beak
49. Corolla tube > 4 mm long; corolla lobes < 2 times as long as wide, not inrolled at margins; anthers glabrous dorsally **Trachelospermum**
49. Corolla tube < 3 mm long; corolla lobes > 2 times as long as wide, usually slightly inrolled at margins; anthers pubescent externally **Cleghornia**
48. Disk 5-crenate or annular; seeds with an apical beak **Anodendron**
34. Leaves with a strong intramarginal nerve
50. Corolla tube > 4 mm long, lobes > 7 mm long **Amphineurion**
50. Corolla tube < 3 mm long, lobes < 4 mm long **Cleghornia**
19. Trees or erect shrubs
51. Corolla lobes overlapping to the left in bud
52. Stamens adnate to the style head; corolla with a corona (except in *Wrightia religiosa*); seeds with a coma of hairs directed towards the base of the fruit **Wrightia**
52. Stamens free from the style head; corolla without a corona; seeds without a coma.
53. Disk present; fruit a drupe **Rauvolfia**
53. Disk absent; fruit a berry or follicle
54. Branching not appearing dichotomous; intramarginal nerve present; fruit a berry; seeds not arillate **Hunteria**
54. Branching appearing dichotomous; intramarginal nerve absent; fruit of paired follicles; seeds arillate **Tabernaemontana**

51. Corolla lobes overlapping to the right in bud
55. Corolla infundibuliform, widening around the middle; fruit of paired erect follicles, surface smooth **Spirolobium**
55. Corolla salverform; fruit of drupes or paired follicles, if follicles erect then surface lenticellate
56. Stamens adnate to the style head; seeds with coma of hairs directed towards base of fruit **Kibatalia**
56. Stamens free from the style head; seeds simple or with coma of hairs directed towards apex of fruit
57. Disk absent; fruit of paired follicles; seeds with coma of hairs **Holarrhena**
57. Disk of 2 lobes; fruit of paired or solitary (by abortion) drupes; seeds simple **Kopsia**

GENERA TO BE UPDATED FOR THAILAND

New species of Apocynaceae, subfamilies Apocynoideae and Rauvolfioideae, have been described from Thailand in the genera *Kamettia* (Middleton *et al*., 2006), *Kopsia* (Middleton, 2004b), *Pottsia* (Middleton, 2001) and *Wrightia* (Middleton & Santisuk, 2001; Middleton, 2007b). New records have been recorded in *Trachelospermum* (Middleton, 2002) and *Chilocarpus* (Middleton, 2007c). Also, as the *Flora of Thailand* includes commonly cultivated plants, *Wrightia antidysenterica* L. should now be included as it has become a common sight throughout Thailand. Updated keys to *Chilocarpus, Pottsia, Trachelospermum* and *Wrightia* were published along with the new species and records mentioned above. They are reproduced here (except for *Wrightia* – see below), along with new keys for *Aganosma*, *Ichnocarpus*, *Kopsia* and *Micrechites* so that this account can be of practical use along with the original Flora account. Amended generic descriptions are also given for each genus.

Aganosma (Blume) G.Don, Gen. Syst. 4: 77. 1837.

Large or medium-sized woody climbers. *Leaves* opposite; usually with an interpetiolar ridge bearing colleters. *Inflorescence* terminal, sometimes also axillary, cymose, often forming a panicle. *Sepals* narrowly ovate to linear, quite large and showy; colleters in sepal sinuses inside. *Corolla* lobes dextrorse in bud; mature corolla with spreading or erect lobes. *Stamens* inserted in lower half of corolla tube, competely included in the tube; filaments short; anthers fertile in the upper half only, the lower half enlarged, sterile, laterally with lignified guide rails and sagittate appendages at the base; adnate to the style head at two points. *Disk* a continuous ring, flat-topped or 5-lobed. *Gynoecium* 2-carpellate, apocarpous but apically united into a common style; ovules numerous; ovaries pubescent or glabrous; style and style head short. *Fruit* of paired follicles; linear. *Seeds* flattened, narrowly ellipsoid, glabrous; with an apical coma.

Seven species from India and China to Malesia. Five species in Thailand.

1. *Aganosma breviloba* Kerr, Kew Bull. 1937: 92. 1937.
2. *Aganosma cymosa* (Roxb.) G.Don, Gen. Syst. 4: 77. 1837.
3. *Aganosma schlechteriana* H.Lév., Fedd. Rep. 9: 325. 1911.
4. *Aganosma siamensis* Craib, Bull. Misc. Inform. Kew 1915: 433. 1915.
5. *Aganosma wallichii* G.Don, Gen. Syst. 4: 77. 1837.

KEY TO THE SPECIES OF *AGANOSMA* IN THAILAND

1. Corolla glabrous in throat
  2. Corolla lobes elliptic, acuminate; tube 4.1–8 mm long **A. cymosa**
  2. Corolla lobes obovate, truncate; tube 8.3–14 mm long **A. wallichii**
1. Corolla pubescent in throat
  3. Corolla lobes obovate, apex rounded **A. schlechteriana**
  3. Corolla lobes elliptic, apex acute to acuminate
    4. Corolla tube 6.7–10 mm long, lobes 5–8.2 mm long **A. breviloba**
    4. Corolla tube 10–14 mm long, lobes 11–35 mm long **A. siamensis**

Amphineurion (A.DC.) Pichon, Bull. Soc. Bot. France 95: 215. 1948.— *Aganosma* sect. *Amphineurion* A.DC., Prod. 8: 433. 1844.

Large or medium-sized woody climbers, often shrub-like when young but then with scandent or arching stems. *Leaves* opposite; usually with an interpetiolar ridge bearing colleters; blade with a very conspicuous intramarginal vein. *Inflorescence* terminal, sometimes also axillary, cymose, often forming a panicle. *Sepals* narrowly ovate to linear, quite large and showy; colleters in a continuous row inside. *Corolla* lobes dextrorse in bud; mature corolla with spreading or erect lobes. *Stamens* inserted in lower half of corolla tube, completely included in tube; filaments short; anthers fertile in the upper half only, the lower half enlarged, sterile, laterally with lignified guide rails and sagittate appendages at the base; adnate to the style head. *Disk* a 5-lobed ring. *Gynoecium* 2-carpellate, apocarpous but apically united into a common style; ovules numerous; ovaries minutely puberulent to glabrous; style head conical. *Fruit* of paired follicles; linear. *Seeds* flattened, with an apical coma.

One species, *Amphineurion marginata* (Roxb.) D.J.Middleton, in India, Bangladesh, China, Burma, Thailand, Laos, Cambodia, Vietnam, Malaysia, Singapore, Philippines and Indonesia as far east as Ambon.

Chilocarpus Blume, Catalogus 22. 1823.

Climbers. *Leaves* opposite; petiole bases slightly clasping stems forming small intrapetiolar ocrea and connected across the stem forming an interpetiolar ridge; blades with distinct or weakly visible punctae beneath. *Inflorescence* of axillary and/or terminal cymes. *Sepals* usually slightly connate at base, not clasping base of corolla; without colleters inside. *Corolla* lobes sinistrorse, bud drumstick-shaped; mature corolla salverform; lobes falcate. *Stamens* free from the style head, completely included in the corolla tube, inserted around the middle or in lower half of corolla tube; filaments short and narrow; anthers ovate, base cordate, apex acute, fertile entire length. *Disk* absent. *Ovary* syncarpous, unilocular with 2 parietal placentas, glabrous; ovules numerous; style filiform, separated from the ovary by an articulation, style head unspecialised. *Fruit* a berry/capsule, fleshy when young; dehiscing into two parts when mature. Seeds with a corky aril; ovoid.

14 species in Southeast Asia and through Malesia to Papua New Guinea. Three species in Thailand.

1. *Chilocarpus costatus* Miq., Fl. Ind. Bat. 2: 393. 1856.

2. *Chilocarpus denudatus* Blume, Bijdr. 1025. 1826.
3. *Chilocarpus rostratus* Markgr., Blumea 19: 165. 1971.

KEY TO THE SPECIES OF *CHILOCARPUS* IN THAILAND

1. Secondary venation prominent beneath, distinct from weaker parallel veins; corolla tube 6–21.5 mm long **C. costatus**
1. Secondary venation not prominent beneath, not particularly distinct from parallel veins; corolla tube 2.5–6.8 mm long
   2. Leaves elliptic; pedicels > 1 mm long; corolla tube 2.5–4 mm long **C. denudatus**
   2. Leaves obovate or spathulate, more rarely elliptic; pedicels up to 1 mm long; corolla tube 4.5–6.8 mm long **C. rostratus**

Kamettia Kostel., Allg. Med. Pharm. Fl. 3: 1062. 1834.

Climber. *Leaves* verticillate, more rarely also opposite but never exclusively so, veins mostly anastomosing into an intramarginal vein; colleters in petiole axils. *Inflorescence* terminal, lax, dichasial, often umbelliform at first node. *Sepals* without colleters inside. *Corolla* lobes overlapping to the left in bud; mature corolla salverform with the tube slightly to quite strongly curved. *Stamens* free from the style head; inserted in lower half of corolla tube, completely included in tube; filaments thin and short; anthers ovate, base cordate, fertile most of length. *Disk* absent. *Gynoecium* 2-carpellate, apocarpous but apically united into a common style; ovules numerous; ovaries glabrous; style short; style head ellipsoid, apex acuminate. *Fruit* of paired fusiform follicles, these divergent, often lenticellate. *Seeds* flattened, with a wing at both ends.

Two species, one in the Western Ghats of India, the other, *Kamettia chandeei* D.J.Middleton, in Phetchaburi Province of Thailand.

Ichnocarpus R.Br., Asclep. 50. 1810.

Climbers or trailers. *Leaves* opposite. *Inflorescence* terminal and/or axillary, often thyrsoid. *Sepals* with or without colleters in the axils. *Corolla* lobes dextrorse in bud, asymmetrical with a slant to the right; tube cylindrical or somewhat inflated, widening at the point of stamen insertion and somewhat constricted at the throat; mature corolla salverform. *Stamens* inserted at around the middle of the corolla tube, completely included within the tube; filaments short; anthers fertile in the upper half only, the lower half enlarged, sterile, laterally with lignified guide rails and sagittate appendages at the base. *Disk* of 5 narrow lobes longer than the ovaries. *Gynoecium* 2-carpellate, apocarpous but apically united into a common style; ovules numerous; ovaries pubescent, style head globular. *Fruit* of paired follicles; linear and narrow; pubescent or glabrous. *Seeds* narrowly lanceolate or linear, glabrous, with an apical coma.

Three species from India to Australia. All three species in Thailand.

1. *Ichnocarpus frutescens* (L.) W.T.Aiton, Hort. Kew. ed. 2, 2: 69. 1811.
2. *Ichnocarpus fulvus* Kerr, Kew Bull. 1937: 91. 1937.
3. *Ichnocarpus uliginosus* Kerr, Bull. Misc. Inform. Kew 1937: 92. 1937.

KEY TO THE SPECIES OF *ICHNOCARPUS* IN THAILAND

1. Leaves linear-oblong, 4.8–6.7 x as long as wide; inflorescence < 2 cm long **I. uliginosus**
1. Leaves ovate or elliptic, 1.3–4.4 x as long as wide; inflorescence 1–17 cm long
  2. Branchlets, leaves and inflorescence densely long tomentose; corolla lobes shorter than corolla tube **I. fulvus**
  2. Branchlets, leaves and inflorescence glabrous, pubescent or shortly tomentose; corolla lobes longer than corolla tube **I. frutescens**

Kopsia Blume, Catalogus 12. 1823, *nom. cons*.

Shrubs or small trees, buttresses absent. *Branchlets* lenticellate or not. *Leaves* opposite; bases mostly clasping the terminal bud when young and the stem when older; the opposite pair more or less equal in size; colleters present in the axils. *Inflorescences* terminal, very rarely also with some axillary; dichasial, more rarely trichasial, but often with elongated branches that do not further branch so as to appear somewhat cincinnate; pedunculate or not; subtending bracts and pedicel bracts small. *Sepals* without colleters in the axils; with a gland on the outside just below the apex. *Corolla* lobes dextrorse in bud; mature corolla salverform. *Stamens* inserted around the middle of the tube to near the tube throat, very rarely near base, not exserted from throat; filaments straight, short, thin; anthers ovate, fertile for most of length; free from style head. *Disk* of two lobes alternating with the two free carpels. *Gynoecium* 2-carpellate, apocarpous but apically united into a common style, glabrous or pubescent; style filiform, glabrous; style head with a collar at the base, otherwise short and cylindrical. *Ovules* 2 in each carpel although only one ever develops. *Fruits* of paired drupes, more rarely solitary, ellipsoid to falcate, more or less flattened (hardly at all in *K. arborea*), usually with spur-like appendages facing inwards towards each other (except in *K. arborea*). *Seed* curved, broader at one end, other end acuminate.

24 species from southern China and Burma to northern Australia and Vanuatu. Five species in Thailand. Five species were also recorded in Thailand in Middleton (1999) but the subsequent revision of the genus (Middleton, 2004b) found that *Kopsia macrophylla* Hook.f. is endemic to Peninsular Malaysia and that some of the material identified as this species, along with some identified as *K. fruticosa* rather formed an undescribed species, *Kopsia rosea*.

1. *Kopsia angustipetala* Kerr, Kew Bull. 1937: 42. 1937.
2. *Kopsia arborea* Blume, Catalogus 13. 1823.
3. *Kopsia fruticosa* (Roxb.) A.DC., Prod. 8: 352. 1844.
4. *Kopsia pauciflora* Hook.f., Fl. Brit. Ind. 3: 639. 1882.
5. *Kopsia rosea* D.J.Middleton, Harvard Pap. Bot. 9: 126. 2004.

KEY TO THE SPECIES OF *KOPSIA* IN THAILAND

1. Sepals acuminate; inflorescence congested; corolla completely white; Nong Khai **K. angustipetala**
1. Sepals emarginate to acute; inflorescence variable; corolla colour variable; widespread
  2. Inflorescences with subtending bracts as large as the sepals and flowers clustered at the ends of the inflorescence branch; sepals mostly acute, more rarely obtuse; fruit without a spur or angle **K. arborea**
  2. Inflorescences with subtending bracts somewhat obscure or smaller than sepals, if as large as sepals then flowers not clustered at ends of the inflorescence branch; sepals obtuse to rounded; fruit with a spur or angle on one side.

3. Ovaries glabrous or with just one or two hairs **K. rosea**
3. Ovaries pubescent
4. Inflorescences without elongated branches; corolla pale to dark pink or white with a red or pink "eye"; more than one flower in an inflorescence open at a time; branchlets pubescent **K. fruticosa**
4. Inflorescences with elongated branches but with the flowers congested along these; corolla white or white with a yellow "eye", very rarely with a pink tinge but then only ever one flower in an inflorescence open at a time; branchlets glabrous, more rarely sparsely puberulent **K. pauciflora**

Micrechites Miq., Fl. Ned. Ind. 2: 457. 1857.

Climbers. *Leaves* opposite. *Inflorescence* terminal and/or axillary, often thyrsoid. *Sepals* with or without colleters in the axils. *Corolla* lobes dextrorse in bud, asymmetrical with a slant to the right; tube cylindrical or somewhat inflated, widening at the point of stamen insertion and somewhat constricted at throat; mature corolla salverform. *Stamens* inserted at around the middle of the corolla tube, completely included within the tube; filaments short; anthers fertile in the upper half only, the lower half enlarged, sterile, laterally with lignified guide rails and sagittate appendages at the base; adnate to the style head. *Disk* of 5 lobes or in a ring, shorter than the ovaries. *Gynoecium* 2-carpellate, apocarpous but apically united into a common style; ovules numerous; ovaries glabrous or pubescent, style head cup-shaped. *Fruit* of paired follicles; linear and narrow; pubescent or glabrous. *Seeds* narrowly lanceolate or linear, glabrous, with an apical coma.

Ten species from the Himalayas to New Guinea. Two species in Thailand.

1. *Micrechites polyanthus* (Blume) Miq., Fl. Ned. Ind. 2: 457. 1857.
2. *Micrechites serpyllifolius* (Blume) Kosterm., Reinwardtia 5: 246. 1960.

KEY TO THE SPECIES OF *MICRECHITES* IN THAILAND

1. Corolla lobes much shorter than corolla tube **M. serpyllifolius**
1. Corolla lobes as long as or longer than the corolla tube **M. polyanthus**

Pottsia Hook. & Arn., Bot. Beech. Voy. 198. 1837.

Climber. *Leaves* opposite; no colleters in the axils. *Inflorescence* a large, many-flowered, terminal panicle. *Sepals* with a continuous row of narrow colleters inside. *Corolla* lobes dextrorse in bud; mature flower salverform, base of tube dilated and then becoming narrower before abruptly widening at point of stamen insertion followed by the short upper part of tube; lobes ovate to lanceolate. *Stamens* inserted in the upper half of the tube, at point where the corolla tube widens, strongly exserted from tube; anthers fertile in the upper half only, the lower half enlarged, sterile, laterally with lignified guide rails and sagittate appendages at the base; adnate to the top of the style head by a patch at the inside base of the anther and by another in the middle of the anther. *Disk* of 5 narrow lobes, connate at the base, or of a dentate ring. *Gynoecium* 2-carpellate, apocarpous but apically united into a common style; ovules numerous; style inflated for most of length or for a short segment; style head collared. *Fruit* of paired narrow follicles; often spiral; glabrous. Seeds narrowly elliptic,with an apical coma.

3 species in India, China and South-East Asia. 2 species in Thailand.

1. *Pottsia densiflora* D.J.Middleton, Harvard Pap. Bot. 6: 285. 2001.
2. *Pottsia laxiflora* (Blume) Kuntze, Rev. Gen. Pl. 1: 416. 1891.

KEY TO THE SPECIES OF *POTTSIA* IN THAILAND

1. Inflorescences compact, axes robust, generally ≤10 cm long; style abruptly and distinctly inflated only for a short space slightly above the top of the disk; disk in a ring and toothed **P. densiflora**
1. Inflorescences lax, axes delicate, generally > 10 cm long; style inflated for most of style length; disk of five free narrow lobes **P. laxiflora**

Trachelospermum Lem., Jard. Fleur. 1: t.61. 1851, *nom. cons.*

Climbers. *Leaves* opposite, those of a pair equal; interpetiolar line with row of colleters; secondary veins anastomosing before margin. *Inflorescence* a terminal and/or axillary cyme; bracts small. *Sepals* with a row of colleters inside. *Corolla* in bud a narrow tube, bulging around the anthers, lobes dextrorse; salverform when open; lobes obovate, asymmetrical and slanting to the right. *Stamens* (sub)sessile, completely included in tube or exserted; anthers fertile in the upper half only, the lower half enlarged, sterile, laterally with lignified guide rails and sagittate appendages at the base; adnate to the style head at ventral base of anther attachment to the filaments and again about middle of anther. *Disk* of 5 separate lobes or partially fused at base, glabrous. *Gynoecium* 2-carpellate, apocarpous but apically united into a common style, often semi-inferior; ovules numerous; style filiform; style head small. *Fruit* of paired follicles; fusiform. *Seeds* linear, glabrous, with an apical coma.

6-10 species from India and Japan to western Indonesia. Three species in Thailand.

1. *Trachelospermum asiaticum* (Sieb. & Zucc.) Nakai in Mori, Pl. Cor. 293. 1922.
2. *Trachelospermum axillare* Hook.f., Fl. Brit. Ind. 3: 668. 1882.
3. *Trachelospermum lucidum* (D.Don) K.Schum. in Engler & Prantl, Nat. Pflanzenfam. 4(2): 173. 1895.

KEY TO THE SPECIES OF *TRACHELOSPERMUM* IN THAILAND

1. Corolla red; stamens inserted in lower half of corolla tube; follicles joined at base and apex **T. axillare**
1. Corolla white or greenish; stamens inserted in upper half of corolla tube; follicles joined only at base
  2. Stamens slightly exserted from corolla mouth which is pubescent in 5 patches **T. asiaticum**
  2. Stamens not exserted from corolla mouth which is continously pubescent **T. lucidum**

Wrightia R.Br., Prod. 467. 1810.

Since the publication of the *Flora of Thailand* account (Middleton, 1999) two species have been described as new (Middleton, 2007b; Middleton & Santisuk, 2001) and one more, *Wrightia antidysenterica* L., is now widely cultivated. Here I am providing a list of the known species but new collections of possibly undescribed species have recently come to my attention and a new fuller account will be published once this is clarified. A key to the currently known species is provided in Middleton (2007b).

1. *Wrightia antidysenterica* (L.) R.Br., Asclep. 63. 1810.
2. *Wrightia arborea* (Dennst.) Mabb., Taxon 26: 533. 1977.
3. *Wrightia coccinea* (Roxb.) Sims, Bot. Mag. 53: t.2696. 1826.
4. *Wrightia dubia* (Sims) Spreng., Syst. Veg. 1: 638. 1825.

5. *Wrightia laevis* Hook.f., Fl. Brit. Ind. 3: 654. 1882.
6. *Wrightia lanceolata* Kerr, Kew Bulletin 1937: 89. 1937.
7. *Wrightia lecomtei* Pitard, Fl. Indo-Chine 3: 1118. 1933.
8. *Wrightia pubescens* R.Br. subsp. lanitii (Blanco) Ngan, Ann. Missouri Bot. Gard. 52: 153. 1965.
9. *Wrightia religiosa* (Teijsm. & Binn.) Benth. ex Kurz, J. As. Soc. Beng. 46(2): 258. 1877.
10. *Wrightia siamensis* D.J.Middleton, Thai Forest Bull., Bot. 35: 80. 2007.
11. *Wrightia sirikitiae* D.J.Middleton & Santisuk, Thai Forest Bull., Bot. 29: 1. 2001.
12. *Wrightia viridiflora* Kerr, Bull. Misc. Inform. Kew 1937: 90. 1937.

REFERENCES

Endress, M.E. & Bruyns, P.V. (2000). A revised classification of the Apocynaceae s.l. Botanical Review 66: 1–56.

Endress, M.E., Sennblad, B., Nilsson, S., Civeyrel, L., Chase, M.W., Huysmans, S., Grafstrom, E. & Bremer, B. (1996). A phylogenetic analysis of Apocynaceae s. str. and some related taxa in Gentianales: A multidisciplinary approach. Opera Botanica Belgica 7: 59–102.

Endress, M.E., Liede-Schumann, S. & Meve, U. (2007). Advances in Apocynaceae: the Enlightenment, an Introduction. Annals of the Missouri Botanical Garden 94: 259–267.

Forster, P. I. (1992). A taxonomic revision of *Ichnocarpus* (Apocynaceae) in Australia and Papuasia. Australian Systematic Botany 5: 533–545.

Larsen, K. & Chayamarit, K. (2006). List of families and contributors. At: http://www.dnp.go.th/botany/BOTANY_eng/flora_listrevised.html (accessed 2 June 2009).

Livshultz, T., Middleton, D.J., Endress, M.E. & Williams, J. 2007. Phylogeny of Apocynoideae and the APSA clade. Annals of the Missouri Botanical Garden 94: 323–361.

Meve, U. (2002). Species numbers and progress in asclepiad taxonomy. Kew Bulletin 57: 459–464.

Middleton, D.J. (1994). A taxonomic revision of *Ichnocarpus* (Apocynaceae). Blumea 39: 73–94.

_____. (1996). A revision of *Aganosma* (Bl.) G.Don (Apocynaceae). Kew Bulletin 51: 455–482.

_____. (1999). Apocynaceae. Flora of Thailand 7(1): 1–152.

_____. (2001). A new species of *Pottsia* (Apocynaceae: Apocynoideae) from Thailand and Lao PDR. Harvard Papers in Botany 6: 285–287.

_____. (2002). *Trachelospermum axillare* Hook.f. (Apocynaceae), a new record for Thailand. Thai Forest Bulletin (Botany) 30: 28–30.

_____. (2004a). Apocynaceae. Tree Flora of Sabah and Sarawak 5: 1–61.

Middleton, D.J. (2004b). A revision of *Kopsia* Blume (Apocynaceae: Rauvolfioideae). Harvard Papers in Botany 9: 91–144.

_____. (2007a). Apocynaceae, subfamilies Rauvolfioideae and Apocynoideae. *Flora Malesiana* 18: 1–471.

_____. (2007b). A new species of *Wrightia* (Apocynaceae: Apocynoideae) from Thailand. Thai Forest Bulletin (Botany) 35: 80–85.

_____. (2007c). *Chilocarpus rostratus* (Apocynaceae: Rauvolfioideae), a new record for Thailand. Thai Forest Bulletin (Botany) 35: 86–88.

_____. (2010a). Apocynaceae, subfamilies Rauvolfioideae and Apocynoideae. Flora of Peninsular Malaysia, in press.

_____. (2010b). Apocynaceae, subfamilies Rauvolfioideae and Apocynoideae. Flore du Cambodge, du Laos et du Vietnam, in press.

Middleton, D.J. & Santisuk, T. (2001). A new species of *Wrightia* (Apocynaceae: Apocynoideae) from Thailand. Thai Forest Bulletin (Botany) 29: 1–10.

Middleton, D.J., Lindsay, S. & Suddee, S. (2006 [‘2005’]). A new species of *Kamettia* (Apocynaceae: Rauvolfioideae), a genus new to Thailand. Thai Forest Bulletin (Botany) 33: 75–80.

Potgieter, K. & Albert, V. A. (2001). Phylogenetic relationships within Apocynaceae s.l. based on *trn*L intron and *trn*L-F spacer sequences and propagule characters. Annals of the Missouri Botanical Garden 88: 523–549.

Sennblad, B. & Bremer, B. (1996). The familial and subfamilial relationships of Apocynaceae and Asclepiadaceae evaluated with *rbc*L data. Plant Systematics and Evolution 202: 153–175.

_____. (2000). Is there a justification for differential a priori weighting in coding sequences? - a case study from rbcL and Apocynaceae. Systematic Biology 49: 43–55.

Sennblad, B., Endress, M.E. & Bremer, B. (1998). Morphology and molecular data in phylogenetic fraternity: the tribe Wrightieae (Apocynaceae) revisited. American Journal of Botany 85: 1143–1158.

Simões, A.O., Livshultz, T., Conti, E, & Endress, M.E. (2007). Phylogeny and systematics of the Rauvolfioideae (Apocynaceae) based on molecular and morphological evidence. Annals of the Missouri Botanical Garden 94: 268–297.