CHAPTER IV

DISCUSSION

1. The chemotaxonomic significance of alkaloids in the Naucleeae

Some genera of the Rubiaceae (e.g. *Cinchona*, *Cephaelis*) are sources of medicinally important alkaloids. Members of the family produce alkaloids of three major types which although based on either quinoline (e.g. quinine), isoquinoline (e.g. emetine) or indole (e.g. yohimbine) ring system, are biosynthetically related, since all are partially derived from secologanin.(60)

The Naucleeae, in particular, are in a state of taxonomic confusion. Phytochemically, there is a strong affinity with the alkaloids found in *Mitragyna* and *Uncaria*, this suggests a close relationship with these genera. Morphologically, in *Mitragyna* and *Uncaria*, the ovules are vertically imbricate on a pendulous placenta and there is no arillus. The wood anatomy deviates from the other members of the Tribe Naucleeae, K. Schumann.(61)

The relationships among members of the Tribes are clearly shown in the Naucleeae or the Cinchoneae. The problem of relationships is centred around the delimitation of the tribes. The Naucleeae have been considered to be a homogeneous tribe by most botanists, Airy Shaw even followed Wernham(72) in considering the group as a separate family (Naucleaceae), but Bremekamp(63) has questioned this concept.

A re-examination of the component taxa has shown that the only character they have in common is the aggregation of the flowers into a spherical head. This feature occurs spasmodically in many tribes and cannot be considered of significance. Besides *Cephalanthus*, two other genera must also be excluded from the Naucleeae: *Mitragyna* and *Uncaria*. Both of the latter genera were considered by Haviland[73] to occupy a distinctive position in the tribe and were placed into separate subtribes by him. The pendulous placentae bearing numerous vertically imbricate ovules, the nature of the placentae, and the construction and dehiscence of the fruit all indicate that the two genera have greater affinity with the Cinchoneae than with the Naucleeae. Evidence from phytochemistry in the nature of the indole alkaloids together with the similarities of the growth organisation and form indicates and strong relationship among *Cephalanthus*, *Mitragyna* and *Uncaria*.[74] In reappraising the character of these two genera (*Mitragyna* and *Uncaria*) and the tribe Cinchoneae, it became apparent that there is a possibility that the Cinchoneae sensu K. Schumann are also still a heterogeneous assemblage of taxa. The investigation of this problem is still in the initial stage and at the moment little can be said over the interrelations of the remainders of the Cinchoneae and of the Cephalantheae. However, the exclusion of *Mitragyna* and *Uncaria* from the Naucleeae[62] results in *Cephalanthus* having a low level of relationship with the Naucleeae sensu K. Schumann.

It is considered that the Naucleeae are a relatively

primitive group, with closest affinity to the tribe Cinchoneae. The inflorescences are highly modified and may be viewed as condensed or reduced, and they are all very similar. The only character that the genera of the tribe have in common is the arrangement of the inflorescence in a spherical head, a feature recurring independently in many tribes. The genera *Mitragyna* and *Uncaria* are now placed together in a subtribe Mitragyninae and transferred to the tribe Cinchoneae; *Cephalanthus* has been transferred into a separate tribe "Cephalantheae", a move first suggested by Bremekamp.(63)

Oxindole and heteroyohimbine alkaloids are reported only from the tribes Cinchoneae and Cephalantheae, in which the tribal delimitation has been debated.(63) *Mitragyna* and *Uncaria*, traditionally placed in the Naucleeae are good sources of oxindole and heteroyohimbine alkaloids and thus it seemed possible that a knowledge of the alkaloids in other members of the Naucleeae might assist in unravelling generic relationships.

The pyridino-carboline alkaloids, also reported from species of *Mitragyna* and *Uncaria*(52) and other members of the tribe Naucleeae such as *Nauclea*, *Anthocephalus* but never found in several species of *Cephalanthus*.(60) However, *Mitragyna* and *Uncaria* have morphological and anatomical affinities with the Cinchoneae inclusive genera producing heteroyohimbines and oxindoles. Inclusion of *Cephalanthus* in the Naucleeae has been questioned,(63) in considering its isolated position perhaps it would be better placing

it in a separate tribe. The presence and nature of the alkaloids of *Mitragyna* and *Uncaria* tend to support the taxonomic idea that these genera together with *Cephalanthus*, stand apart from the rest of the Naucleeae and that their exclusion would result in a taxonomically homogeneous tribe. Hence different kinds of alkaloids proved useful in assessing the taxonomic relationships, although further information is required on the distribution of alkaloids. It is interesting to note that the presence of iridoid carboline glycosides in *Adina*, *Anthocephalus*, and *Nauclea* is one of the significant means for separation of the said genera from the Cinchoneae and the Cephalantheae to a unique tribe Naucleeae.

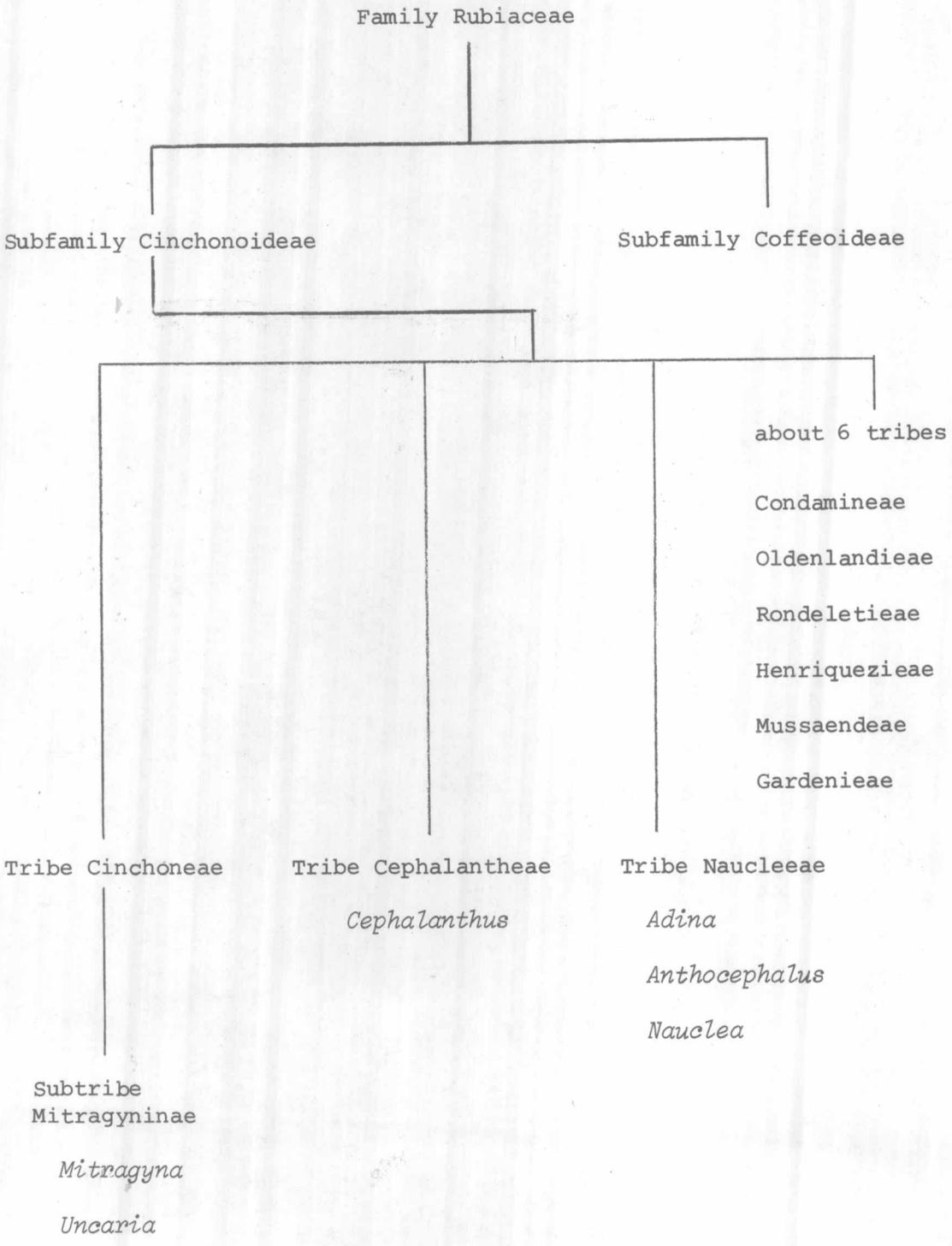
Family Rubiaceae
Subfamily Cinchonoideae
Subfamily Coffeoideae
about 6 tribes
Condamineae
Oldenlandieae
Rondeletieae
Henriquezieae
Mussaendeae
Gardenieae
Tribe Cinchoneae
Tribe Cephalantheae
Cephalanthus
Tribe Naucleeae
Adina
Anthocephalus
Nauclea
Subtribe
Mitragyninae
Mitragyna
Uncaria

Table 1

Occurrence of some alkaloids and glycosides in some members of Subfamily Cinchonoideae

	Indole alkaloid	Oxindole alkaloid	Iridoid carboline glucoside	Pyridino carboline alkaloid
Tribe Cinchoneae Subtribe Mitragyninae	+	+	-	+
Tribe Cephalanthae	+	+	-	-
Tribe Naucleeae	rare in *Nauclea*, *Adina*	-	+	+ except in *Adina*

after (36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 50, 53, 54, 56, 57, 67)

Table II

Comparison of morphology of parts of plants in some members of Subfamily Cinchonoideae

	Tribe Cinchoneae Subtribe Mitragyninae	Tribe Cephalanteae	Tribe Naucleeae
Fruit	Fruitlet free on the receptacle separate dry and dehiscent	Loosely cohering head and indehiscent cocci (Pseudo-syncarp)	Fruitlet connate into an indehiscent syncarp
Endocarp	Endocarp of fruit splitting from top to bottom	Endocarp splitting from bottom to top	Endocarp splitting from bottom to top
Aril	Arillus absent	Funicle with a well developed arillus	Arillus absent
Ovary	Ovules and seeds of each placenta upwardly imbricate along the pendulous placenta	Ovules solitary apically attached to the septum, pendulous, anatropous	Ovules solitary to numerous, ovules and seeds of each placenta either (predominately) pendulous : or spreading in all direction, never upwardly imbricate along the whole length of the placenta
Seed	Winged	Wingless	Wingless

after (61, 62, 63, 73)

2 . Biogenetic consideration

The number of known indole alkaloids has increased sharply over the last few years and there are now about six hundreds. Certain complex indole alkaloids, such as heteroyohimbine, yohimbine, and corynantheine analogues derived from tryptamine residue and secologanin. Vincoside and isovincoside (Strictosidine) as precursors for these afore mentioned alkaloids are found in subfamily Cinchonoideae together with quinoline alkaloids in *Cinchona*.

Out of quinoline, other alkaloids found in the tribe Cinchoneae are related to indole alkaloids of *Mitragyna* and *Uncaria* e.g. Cinchonamine in *Cinchona*,[75] corynantheine in *Pseudocinchona* and *Corynanthe*.[67]

Not only the alkaloids constituents but also the biogenetic pathways of those alkaloids in *Mitragyna* and *Uncaria* and of the Cinchoneae illustrated their closed affinity.

The presence of indolic glucoside in the Naucleeae is a great different point between the other tribes. Evidence has shown that sugar moiety was cleaved by enzyme β-D-glycosidase.[45]

It could be considered that the tribe Cinchoneae and Cephalantheae might have enzyme(s) which break(s) down sugar moiety from vincoside or isovincoside to various groups of indole alkaloids through the step of alkaloids biogenesis. Lacking of the appropriate enzyme in the biogenetic pathway of the Naucleeae, results in the occurrence of glycoalkaloids.

Since neither oxindole, nor glycooxindole alkaloids could be detected in this investigation, and oxindoles have not yet been reported in the Naucleeae; the biogenetic pathway based on condensation to the intermediate spiroindolenine and finally oxidised to oxindole as proposed by Woodward[71] cannot be accounted for.