A. Evolutionary tendencies within the genus

It is remarkable indeed that a relatively small genus, *Alangium* with 18 species should exhibit conspicuous diversity of morphological features. From a phylogenetic standpoint this would mean that the trends of specialization in the various organs, structures, tissues, cells etc., have been accomplished along diverse lines and also that the relative rates of evolutionary specialization are subject to relative acceleration or retardation. Some of these tendencies have already been briefly summarized towards the concluding part of each preceding chapter of this writing. Therefore a re-statement in detail of the conclusions is not attempted in this section, in order to avoid redundancy or repetition. In the ensuing discussion the subgeneric sections as proposed by Bloembergen (1939) have been adhered to.

From the point of view of geographical distribution of the genus, the constituent species occur within specific limits. As has been observed earlier, the largest concentration of the species is seen between 10° north and 10° south of equator in the Old World. The species of the section *Conostigma* possess a relatively restricted limit on either side of the equator. Although this restricted area cannot be strictly spoken of as being southern in relation to the equator, it would yet be quite appropriate
appropriate to consider these as typically southern
when compared with the remaining three sections of the
genus, because the latter sections exhibit an increasing
preference to latitudes north of equator, although the
southern limit of some of the species may be on the
neighbourhood of equator; furthermore, five species in
the sections Angolum and Marlea are wholly northern. Such
a pattern of distribution of the species indicates in a
broad way that starting from the section Conostigma with
its essentially restricted range, the other three sections
exhibit conspicuous extension into the northern latitudes.

1) Taxonomic features: The leaves in sections
Conostigma and Rhytidandra are dominantly pennisiered,
while those in Marlea and Angolum exhibit pinnerved or
palminerved condition in a dominating degree, in addition
to the pennisiered condition. The inflorescence types
in the genus Alangium are essentially of the monopodial
and sympodial types. Both these types occur in sections
Conostigma and Rhytidandra and in only two of the eight
species of Marlea. In the remaining six species of Marlea
the inflorescence is typically sympodial. Exclusive
monopodial inflorescence is confined to Angolum. Both
bracteate and ebracteate types of inflorescences occur
in Conostigma, and only ebracteate types in Rhytidandra
and Marlea and exclusively bracteate type in Angolum.
The peduncle in the genus Alangium presents two more or less
distinct
distinct levels of variability - sessile and long. Both types of peduncles occur in Conostigma. The peduncles are uniformly and consistently long in Rhytidandra and Marlea. The inflorescence of Angolum however is typically sessile. There appears to be a strong tendency towards reduction in the number of flowers per inflorescence as one proceeds from Conostigma to Marlea. Although the number of flowers per inflorescence in sections Conostigma, Rhytidandra and Marlea average seventy, it is only four in the section Angolum. Although this feature appears to be of a numerical category, still the enormous difference between Angolum on the one hand, and the remaining three sections on the other is noteworthy. In the latter three sections the number of stamens per flower is equal to the number of the calyx or the corolla lobes, while in Angolum the stamens always occur in multiples of two to six times the number of perianth lobes. The style in Conostigma is uniformly obtuse-conical, thickened from tip to base and the stigma four-grooved. In Rhytidandra the style is thickened from base to tip more or less split and the stigma two-lobed. In sections Marlea and Angolum the style is cylindrical, the stigma capitate and uniformly four-lobed. The ovary is one-celled and one-ovuled in Conostigma, Rhytidandra and Angolum, while in Marlea four species possess the same character and the remaining species are two-celled and two-ovuled. The smooth surfaced endosperm occurs in Conostigma, Rhytidandra and Marlea, whereas the grooved endosperm characterises Angolum.
It may also be observed that the average size of the fruit in *Conostigma* is large while that in the other three sections is relatively smaller.

2) Anatomical features:

a) **Primary xylem** - Section *Conostigma* stands apart by the possession of relatively primitive features. Thus, the vessels of the metaxylem are significantly longer with scalariform perforation plates containing a larger number of bars, as compared with the corresponding cell types in the remaining three sections which in turn exhibit significantly shorter vessel members with fewer number of bars on the perforation plates.

b) **Secondary xylem** - Well-defined demarcation of growth ring formation is absent in *Conostigma*, *Hystidendra* and *Angolum*. In *Marlea* the definition is subject to variability. It should also be noted that there appears to be both facultative and obligative types of ring-porosity in the woods of this section. Some of the species particularly of the northern geographical limits exhibit typical ring-porous secondary xylem.

Just as the section *Conostigma* stands apart from the remaining sections in regard to the characteristics of the primary xylem, so also it is in regard to the secondary xylem. The average length of vessel members is significantly longer, the perforation plates scalariform and the transectional outline of the pore relatively angular. This situation
situation is in sharp contrast to that in the other three sections where the vessel members are significantly shorter with simple porous perforations and perfectly circular or oval cross-sectional outline. The inter-vessel pitting in Conostigma appears to have undergone a rather precocious trend of specialization in possessing relatively crowded small pit pairs in contrast to the more or less widely spaced large conspicuously bordered pit pairs in alternate alignment in the remaining three sections. The vessel-ray pitting in Conostigma is of the scalariform or transition from scalariform to opposite type in conformity with the level of specialization of the end wall of the vessel. In the other three sections the pits are circular to oval in outline and are arranged in the alternate or in irregularly crowded fashions. The rays in Conostigma and Angolium are subjected to very little modification during ontogeny. Thus, both in the early formed and later formed parts of the secondary xylem, the ray system conforms to the relatively primitive Heterogenous condition. But in sections Marlea and Rhytidandra the ontogenetic modification of the rays is diverse, whereby in the mature wood the uniseriate rays become almost eliminated and the multiseriate rays assume homogeneity of the constituent cells associated with a drastic reduction or total elimination of the uniseriate wing part. Thus, these two sections exhibit a higher level of ray organization than in Conostigma and Angolium. The wood parenchyma
in *Conostigma* is typically apotracheal, occurring in diffuse or diffuse-in-aggregate patterns. A similar relatively unmodified primitive level of specialization is encountered in *Rhystidandra* and *Angolum Marlea*, however, exhibits a relatively higher level of specialization in that the parenchyma becomes aggregated in paratracheal patterns of distribution also. The morphological nature of the imperforate tracheary cells in *Conostigma* exhibits more tracheid-like features in spite of the rather heavily thickened secondary walls in contrast to the corresponding cells in the remaining three sections wherein they possess decidedly fibre-like features. Thus a summation of the features of secondary xylem as a whole clearly indicates that the section *Conostigma* exhibits a large proportion of characters that speak of a relatively low level of structural specialization than what obtains in the remaining three sections.

c) **Nodal anatomy** - All the species of the genus exhibit a stabilized pattern of nodal structure in that the pattern conforms to the trilacunar type. There appears to be a definite trend for the median vein to undergo rather precocious trifurcation in *Angolum* and *Marlea*, while in *Rhystidandra* and *Conostigma* the level of trifurcation is delayed until after the leaf strand moves farther away from the corresponding lacuna of the axial.
axial stele. The section Conostigma exhibits a peculiar trend of specialization in that the median and lateral leaf strands undergo a higher degree of splitting, torsion and recombination, associated with a pronounced tendency of the individual bundle to become concentric in contrast to the situation in the remaining three sections. Thus, even in regard to such a minute character the section Conostigma appears to exhibit certain trends of modifications which are not duplicated in any other section.

d) Petiolar vasculature - A summary of this topic is already presented on page 62 of the text and therefore a detailed review is likely to be mere repetition. It may, however, be repeated that the petiolar vasculature in the genus is remarkably characteristic in the sense that the ranges of variability of the vascularization patterns are specific to the subgeneric sections. From the point of view of phylogeny this situation would mean that the trends of anatomical specialization in each section have followed independent ways. The possession of concentrically distelie petioles is exclusive to Conostigma, while monostelic petioles occur in the remaining sections. The petioles of Acantholium and Phytidandra are characterized by the absence of medullary vascular tissue while in Marica it is present.

e) Vascularization of the leaf - The trends in the specialization of the patterns of foliar vascularization are
are often subtle, and broad exploratory surveys leading towards the establishment of evolutionary lines of specialization have not been studied in angiosperms. However, that such a study may reveal salient evolutionary patterns is indicated by some of the intensive studies that have been initiated recently at Harvard University on some of the ranalean families and subsequently at the Berkeley Campus of the University of California on some genera of Melastomaceae, Malvaceae etc. Although the major trends of specialization for the dicotyledons as a whole have not been established, such studies undoubtedly become helpful towards a better understanding of the interrelationships within smaller taxonomic category irrespective of their directions of specialization. However, because such studies are still at the initial stages, the concerned data should be utilized with great caution. A detailed account of the structural features of foliar vascularization has already been given under the respective topic. In so far as the genus Alangium is concerned, in the leaves of Conostigma and Rhytidandra the vein system is generally coarser and the areolar limits are less defined. In section Conostigma there is a pronounced emphasis towards a denser and more profuse distribution of the intrareolar vasculature. In contrast to this situation the leaves of Marlea and Angelium show relatively well-defined areolar limits, rather slender vein system and more or less sparse distribution of vasculature within the areoles. The leaves of the section Conostigma
Conostigma are conspicuously thicker than those of other sections. This feature is associated with the presence of wavy epidermal cells, hypodermis and a single layer of palisade parenchyma. The veins and veinlets are jacketed by a double layer of sheathing cells, the inner layer being sclerenchymatous. In section Rhytidandra these features are absent but instead the number of palisade layers is two. In Marlea there is a minor tendency for the adaxial epidermal cells to become protuberant and in this section also the hypodermis is absent and the palisade layer is generally single. In contrast to the condition in Conostigma, the jacketing cells of veins and veinlets are parenchymatous. The general histological features of Angolum resemble those of Marlea.

f) Pubescence - The section Conostigma exhibits a remarkable representation of the hair types. Thus, five out of six types of pubescence are met with in this section. It may be noted in addition that the multicellular uniseriate type of hair is found only in this section. In Rhytidandra and Angolum only erect, reclinate and articulate types of hairs occur, while in the section Marlea the only types that are seen are erect and reclinate (Table VIII).

g) Alkali extract - When the leaves were being treated for clearing with Sodium or Potassium hydroxide it was observed that the solution extracted colouring matter in varying shades in a given time. The solvent in the section Conostigma
Conostigma was invariably dark brown or tan while the solution in the other sections exhibited colours ranging from light greenish yellow to golden brown. It may also be noted in this connection that the parenchymatous tissues, in general, in Conostigma show a very conspicuous cell inclusion of tannins or phenolic compounds, in contrast to the other sections wherein such cell inclusions are either very infrequent or absent.

h) Floral anatomy - In this respect also the species of Conostigma exhibit uniqueness. The receptacular stelar bundles are fewer in number and these break up into as many vascular strands as the number of floral appendages at the basal level of the ovary. In other words, determination of the vascular traces that supply the floral parts is accomplished towards the basal levels of the inferior ovary. Furthermore, many of these bundles become concentric, a feature also seen in the petioles of the same section. In the remaining sections, on the other hand, the splitting of the receptacular bundles takes place only at the apical level of the inferior ovary and the bundles are collateral.

1) Pollen - The pollen grains of Conostigma again exhibit certain features that are not duplicated in the other sections. The finely and evenly pitted sporoderm and the vestibule-like modification of the germinal apparatus are exclusive to this section alone. In the other sections, the sporoderm sculpturing conforms to a variable type of coarse
coarse-warty papillations arranged either in stippled or striate fashions. In these sections there is also a trend towards a slight increase in the number of germinal apertures.

j) Embryology: The information available on this aspect is admittedly meagre and only three species have been looked into: A. kurzii (as A. hamballi, Schnerf, 1922), A. salvifolium (as A. lamarkki, Gopinath, 1943) and A. chinense (Mitra & Dutta, 1949). Data gleaned from these sources appear to be as diverse as the other exomorphic and endomorphic features. Whether the differences noted by the respective authors are due to observational errors or due to the inherent features of the species themselves is hard to determine at present. All authors are agreed that the ovule is unitegmic and more or less crassinucellate. The formation of parietal cells and of an integumentary tapetum also appear to be features shared by all the species that have been investigated. The development of the female gametophyte takes place according to the Polygamous type. The differences are more striking. The antipodals degenerate early in A. chinense; they persist till the time of fertilization in A. kurzii; and in A. salvifolium, they are reported to persist even after fertilization and occasionally develop into antipodal embryos. A much more significant difference lies in the type of endosperm. Gopinath (1945) records ab initio nuclear type of development in A. salvifolium whereas Mitra & Dutta (1949) describe ab initio
ab initio cellular development in *A. chinense*. If these differences are not due to errors of observation or of interpretation, then it appears likely that the embryological characters also, when thoroughly investigated, may bring to light diverse trends of specialization in the different sections of the genus. But, as it is, this data can not be made use of to evaluate either the lines of specialization or formulate diagnostic features that may be specific to sub-generic groupings.

k) Chromosome numbers: The only chromosome numbers that are known for the genus *Alansium* are \( n = 11 \) for *A. potentifolium* (as *A. beronifolium*, Wanscher, 1933) and \( n = 8 \) for *A. salixfolium* (as *A. lamarckii*, Gopinath, 1948). Darlington and Janaki Annam (1946) assume the basic chromosome number to be 11 for the family. It is unfortunate that chromosome numbers of other species are not known because the available data fails to signify any possible conclusion and leaves the question open, whether there is a possibility of at least two basic chromosome numbers for the family.

B. Taxonomic groupings of the sub-generic sections:

In his masterly treatment of the taxonomic revision of the genus *Alansium*, Bloembergen (1939) has made a very significant observation: "It would have been possible to elevate the sections to the rank of genera. In that case, we would have got, instead of one sharply limited genus, a number of much less sharply limited smaller ones, of which some even would appear somewhat artificial, and all of them
of them would comprise rather few species. This practice appeared undesirable ..." To a very large extent these words may be repeated with reference to endomorphic characters also. This is particularly so in regard to sections Angelum, Marlea and Rhytidandra.

A summation of exomorphic and endomorphic characters presented above clearly indicates that the species of the section Conostigma possess a good many characters in common, both exomorphically and endomorphically, that are not duplicated in the remaining three sections, taken either singly or together. It is also true that Conostigma possesses certain structural features that exhibit diversified trends of specialization in the other three sections. From the phylogenetic stand point, Conostigma thus appears to be of the nature of a basic complex from which the other sections are derived, though not in any direct way. On the whole, the inter-relationships amongst the four sub-generic sections of the genus appear to be reticulate rather than linear. That this is so is evidenced both in the taxonomic and anatomical characters. Some of these characters that find expression in one or more sections may be absent in others, and vice versa. If this situation was true in reference to all the characters that have been analysed, no amendments would be necessary. But when a summation of characters of Conostigma is compared with that of the remaining three sections, it becomes irresistible to consider the section as a distinct evolutionary level of specialization. This
is particularly so in regard to the features of the xylem. Other features also fall in line with this concept. Therefore, combinations of the salient exomorphic and endomorphic features of the sub-generic sections may be briefly outlined as follows:

Conostigma (geographical distribution restricted to the lower latitudes, north of equator): (a) exomorphic features: leaves penni-nerved, conspicuously thick; style obtuse conical, thickened from tip to base; stigma four grooved; fruit relatively large; (b) endomorphic characters: vessels of the primary xylem as well as of the secondary xylem long; perforation scalariform; intervascular pitting crowded, pits minute; vessel-ray pitting scalariform to transitional to opposite; heterogeneous 1 type of ray system in mature wood; imperforate tracheary cells very thick, yet tracheid-like with conspicuously bordered pits; leaf-trace bundles concentric; petioles containing two or more systems of concentrically arranged vascular bundles; vascularization of the lamina constituted of relatively thick vein system; areolar limits indistinct; hypodermis present; stomatal distribution very dense; alkali extract dark brown or tan; origin of the individual vascular traces supplying the floral parts at the bottom level of the ovary; sporoderm sculpturing finely pitted; vestibule-like modification of germinal apparatus.

Ehytidandra
Rhododendron, Harleya and Ansolium (geographical distribution extended to higher latitudes north of equator, some species occurring only in the northern hemisphere): (a) exomorhpic features: plei-nerved or palmi-nerved or palmately lobed leaves; style either thickened from base to tip or cylindrical; stigma two to four lobed; fruit relatively small; (b) endomorhpic features: vessels of the primary xylem as well as of the secondary xylem short; perforation simple porous; intervascular pitting relatively diffuse, pits large; vessel-ray pitting alternate; ray system commonly tending towards the expression of homogeneity, associated with the homogeneity of component cells; imperforate tracheary cells relatively thin walled yet with reduced pits; leaf-trace bundles collateral; petioles of single stelo with or without medullary bundles; vascularization of lamina constituted of relatively thinner vein system; areolar limits distinct; hypodermis absent; stomatal distribution sparse; alkali extract greenish-yellow to golden brown; origin of the individual vascular traces supplying the floral parts at the top level of the ovary; sporoderm sculpturing constituted of warty protuberances aligned in diverse ways; vestibule-like modification of the germinal apparatus absent.

In addition to the specific features that are exclusive to Copostigma, as has been already pointed out, this section possesses certain other features which lead towards the conclusion that this section constitutes a kind of a complex within
within the genus. Thus, some of the characters that are present in one or more of the remaining sections are also present in this group. The more important features of this type are the presence of both monopodial and sympodial and bracteate and ebracteate types of inflorescences, which become specific to one or more of the remaining sections. Similarly, both sessile and long pedicels occur in *Conostigma*, the feature segregating as a sectional character in one or more of the remaining sections. The paratracehcal parenchyma of *Conostigma* remains as such in *Rhytidandra* and *Angolum* while in *Marlea*, terminal as well as paratracehcal vasicentric types become established. Again, almost all the types of pubescence recorded for the genus occur in *Conostigma* while the pubescence types in the remaining sections are restricted.

Therefore, the whole body of evidence categorically indicates (1) that the species of the section *Conostigma* are bound together by a large number of exomorphic and endomorphic features, a combination of which is not duplicated in other sections of the genus, (2) that the anatomical specialization of the primary and secondary xylem represents a relatively low level of evolutionary modification as compared with the remaining sections of the genus and (3) that the section, in all probability, represents a kind of basic complex from which the other sections appear to have been derived (not necessarily in a linear sequence).

In view
In view of these considerations, it may be asked whether it is still advisable to consider the four sections as sub-generic levels as has been opined by Bloembergen (1939). On the other hand, would it not be in keeping with the summation of evidences to reshuffle the sub-generic sections? In the opinion of the writer, there are very strong arguments for accomplishing such a change. Should a change be instituted, it should be done so on the basis of the following conclusions: The section *Conostigma*, as a whole, stands apart from the remaining sections in very significant exomorphic and endomorphic characters. The magnitude of difference is far higher than that between species. Furthermore, the level of specialization of secondary xylem of *Conostigma* is decidedly the primitive level for the genus as a whole, as constituted at present. This section, therefore, has every qualification to be segregated from the other three sections of the genus whether considered from the point of view of taxonomic characters or from phylogenetic point of view in terms of increasing levels of structural specialization or modification. It may therefore be suggested that section *Conostigma* should be raised to the rank of an independent genus, retaining the thus newly erected genus, however, in the Alangiaceae itself.

C. Taxonomy
C. Taxonomic consideration of the Alangiaceae:

The recognition of *Alangium* as belonging to an independent family, the Alangiaceae, dates back to Wangerin (1910). Previously, the genus *Alangium* was considered as one among twelve genera, all grouped under Cornaceae. Without resorting to a detailed chronological and documented history of the genus *Alangium* or of the Alangiaceae, all authors, since, 1910, appear to have accepted Wangerin's conclusion in so far as the establishment of the family Alangiaceae to accommodate the single genus *Alangium* is concerned. Nor was there any dispute in regard to the constitution of the family, although the validity of Wangerin's procedure in recognizing only two sub-generic sections (*Eualangium* and *Marlea*) does not appear to have met with universal approval. Nearly 30 years later, Bloembergen accomplished a very painstaking task of monographing the Alangiaceae with annotations. It must be said that the degree of taxonomic details and of analysis that have formed the background in Bloembergen's monograph is remarkable. As a result of such thorough study, Bloembergen (1939) recognized four sub-generic sections, although we have on hand a fairly up to date taxonomic treatment of the family, its systematic position continues to be a topic of discussion.

The main views expressed in regard to the taxonomic position
position of Alangiaceae are as follows:

1. Relationship with Cornaceae (Meaolfe & Chalk, 1950; for detailed reference see Horne, 1914)

2. Relationship with Combretaceae (Lindley, 1847; De Candolle, 1868)

The Combretaceous alliance of Alangiaceae was postulated essentially because of the supposed similarities in regard to the number of locules and the inferior ovary. These two characters, although points of similarities, do not constitute genetical relationship. Furthermore, the anatomical characters of the Combretaceae exhibit a relatively far higher degree of structural specialization and also lines of specialization in exomorphic and endomorphic characters that are wholly unrelated to the Alangiaceae. Therefore, the relationships of the Alangiaceae will have to be looked for elsewhere.

The relationships of the Alangiaceae with Cornaceae and its presumed allies, in the opinion of the writer, deserve to be more critically examined. It is unfortunate, that pertinent data with regard to the endomorphic characters of the families concerned, are not available. Therefore, a fuller discussion and a final conclusion should be postponed until such a date when adequate analyses of endomorphic characters become available. Therefore, in the following paragraphs, an attempt is being made to bring together the available data essentially to show the necessity to undertake intensive studies on the families concerned. The information
information that is contained in the following paragraphs has been freely drawn from Metcalfe & Chalk (1950), Adams (1949) and Titman (1949).

The three families, Alangiaceae, Cornaceae and Nyssaceae possess several exomorphic features in common. They are essentially trees or shrubs with alternate exstipulate leaves and flowers borne in inflorescences. The number of carpels in the Alangiaceae is one or two, in the Nyssaceae one and in the Cornaceae, a varying number between one and four. The fruit is a drupe in all the three families; the seeds are endospermous; the flowers in the Alangiaceae are hermaphrodite; in the other two families, they are either bisexual or unisexual. The number of perianth lobes and the number of stamens is subjected to considerable fluctuation in each of these families. In still other exomorphic characters, the three families exhibit diverse trends of structural modification that go to make the individuality of the three families.

In regard to the exomorphic characters, there are again several points of similarities. The differences are essentially those that are of the nature of trends or of different levels of phylogenetic modification. The primary and secondary xylem appear to be least specialized in the Nyssaceae. The vessels bear exclusively scalariform perforation plates with more than 20 bars; the intervacular pitting is scalariform to scalariform-transition to opposite; wood parenchyma is typically apotracheal; the rays are of the primitive
the primitive heterogenous type; and the imperforate tracheary elements are tracheid-like. The xylem of the Cornaceae appear to be more or less at the same level of structural specialization, although, two genera possess single porous perforation with somewhat concomitant modifications in the other tissues of the xylem. In the Alangiaceae, the section Conostigma exhibits an evolutionary level of modification exactly similar to the other two families; the remaining three sections show a far higher level of structural specialization of the xylem as a whole.

The nodal anatomy in all the three families is of the trilacunar type. In the Cornaceae, the petiolar vasculature is very simple. It may consist of an arc of separate strands or of shallow crescentic bundles with one or two adaxial strands. In the Nyssaceae, the situation is very similar. In the Alangiaceae, however, the petiolar vascu-

lature, in addition to exhibiting types similar to the above, also show a remarkable diversity of complex organization.

The leaves in the Nyssaceae, Cornaceae and in section Conostigma of the Alangiaceae are typically penni-nerved, while in the other sections of the Alangiaceae, pleinerved or palminerved or even palmately lobed situation is encon-

tered. The parenchymatous sheathing cells of the veins and veinlets of the Alangiaceae are also duplicated in the leaves of the Nyssaceae; so also, the types of sclereids of the leaves. In the Alangiaceae, however, the morpho-

logical
logical types of sclereids find a diversified expression.

Simple unicellular hairs occur uniformly in all the three families; so also, certain of the glandular types of hairs; in the Alangiaceae, not only the above types are seen but several other morphological modifications also. The stomata is of the ranunculaceous type in the Cornaceae and the Alangiaceae while it is of the rubiaceous type in the Nyssaceae.

The basic chromosome numbers in the Cornaceae, eight, nine, ten and eleven; in the Nyssaceae, it is eleven; although it has been suspected if more than one basic number is involved in the Alangiaceae, it is significant to note that the number eleven also occurs in this family.

In all the three families, the pollen mother cells divide according to the successive type. The pollen grains are two celled at the time of shedding and are tricolporate irrespective of the minute differences in sporoderm sculpturing and stratification. The ovule is crassinucellate with one integument. The development of the female gametophyte is of the Polygonum type, although tetrasporic type is reported to occur, in addition, in a few members of the Cornaceae. The endosperm in the three families is ab initio cellular, although a nuclear type of endosperm is reported in one species of Alangium.

This brief
This brief comparative resume appears to indicate that the three families, Nyssaceae, Cornaceae and Alangiaceae are related more closely to one another than they are to other families. Therefore, if true phylogenetic relationships of the Alangiaceae are to be eventually settled, there is every possibility of discovering larger number of natural similarities should the Nyssaceae and the Cornaceae be subjected to critical and intensive analysis. With the available data, it may also be suggested that of the three families, the Nyssaceae present a very low level of structural specialization of the xylem, successively higher levels having been attained by the Cornaceae and the Alangiaceae. In regard to certain other structures, the latter two families exhibit diverse trends of phylogenetic modification, a fact which makes the three families distinct. A critical evaluation of summation of evidences appear to show unmistakably that the families Nyssaceae, Cornaceae and Alangiaceae constitute a more or less homogeneous grouping.
SUMMARY

Fifteen out of the eighteen putative species of the genus *Alangium* constituting the family *Alangiaceae* have been studied anatomically. The features to which special emphasis has been paid are, primary xylem, secondary xylem, node, petiole, vascularization of the lamina, stomata, pubescence, sclereids, crystals, vascular anatomy of the flower and pollen.

I. Observations

The metaxylem vessels in the genus as a whole possess scalariform perforations. In section *Conostigma*, these vessel members are significantly longer than in sections *Angulam*, *Marlea* and *Rhytidandra*.

The secondary xylem of *Conostigma*, *Rhytidandra* and *Angulam* generally does not exhibit well defined growth rings; in a few species the phenomenon, if present, is not well defined and the degree of expression is subject to fluctuation. The section *Marlea* exhibits a pronounced tendency for the formation of annual rings. It is in this section that ring- or semi-ring-porous condition, although both facultative and obligate methods of growth ring formation are encountered.

The general level of specialization of the secondary xylem as a whole in section *Conostigma* is relatively primitive; the only feature which shows a rather precocious stage of specialization
of specialization is seen in the inter-vessel pitting. This situation is in contrast to that in the remaining three sections wherein the secondary xylem exhibits relatively higher levels of specialization.

The nodal anatomy exhibits a rather stereotyped pattern in the family. Three leaf strands are related to a corresponding number of lacunae of the eustele of the stem. Thus, the nodal anatomy conforms to the trilacunar type. The trifurcation of the median leaf strand in Conostigma and Rhytidandra takes place at a relatively higher level of the node than in sections Angoulium and Marlea.

The vascularization of the petiole in the genus as a whole appears to have followed diverse trends of modifications and the pattern ranges from simple to complex. The simplest type consists in the formation of a petiolar eustele or a stele in which the major segment consists of a single arc. In the second type, one or two medullary bundles become embedded in the ground tissue. Finally, complex patterns are organized by the presence of concentrically placed eustele wherein the individual strands become pronouncedly crescentic or concentric. (Section Conostigma). It has been pointed out that the diverse patterns in the vascular anatomy of the petiole conform to specific ranges of variability in each section and that these ranges do not overlap in the sections.

Therefore
Therefore, the patterns are highly specific to each section and thus provide a means of taxonomic determination. An artificial key for the identification of the sub-generic levels from the features of peltiolar anatomy has been provided.

The vascularization pattern of the foliar lamina conforms to two fundamental categories. In the first category, the areoles are not well defined; the veins and veinlets are relatively coarser (sections Bhtijandria and Conostigma). In the second category, the areoles are relatively well defined and the vein system is relatively slender.

In regard to leaf histology, the section Conostigma presents certain features peculiar to the section. The more important of these are: thicker leaves; presence of hypodermis; double layer of sheathing cells around the veins, the inner one sclerenchymatous. In the other three sections of the genus, not only such a combination of characters is absent but also additional features, like the presence of more than one palisade layer, the jacketing cells of the veins partly parenchymatous, etc., become established.

Four morphological types of sclereids occur in the family. This cell type occurs in the different sections of the genus in varying combinations and proportions, excepting in the section Conostigma; in this section, possibly
possibly, modified parenchymatous cells in close association with the vein system of the leaf become replaced.

Four morphological types of crystals occur in the family, druse, rhomboidal, polyhedral and cubical types. Their distribution in the different parts of a single species is generally diverse, and between species or sub-generic sections also, distribution does not conform to any plan.

Both unicellular and multicellular categories of pubescence occur in the family. Five morphological types in the first category and one morphological type in the second category have been recognised as follows:

(1) Unicellular - (a) erect type (b) reclinate type (c) articulate type (d) uncinate type (e) stellate-peltate type.

(2) Multicellular - uniseriate.

Of these types three occur in Conostigma, two in Marlea and four in Chytidendra in varying combinations.

The leaves of the section Conostigma diffuse dark-tan colour when treated with alkali and in the other three sections, the colour index varies between greenish-yellow and golden brown.

The floral anatomy reveals that the flowers are constructed on a rather uniform pattern. The calyx lobe is supplied.
supplied with a single vascular trace, corolla lobe with a single trace which trifurcates very early, and the stamen is supplied with a single trace. Although there is considerable stability in regard to the number of traces that are connected with the floral appendages, the level of separation of the concerned strands from the receptacular stele differs to some extent. In the section *Conostigma*, the strands become organized at the bottom level of the ovary, whereas in the remaining three sections the splitting is postponed until the top level. It may also be noted that the stamens of *Conostigma* consistently possess a three-trace supply in contrast to the single trace of other sections.

The pollen grains of the family are, as a whole, of the tricolporate category. In *Conostigma*, this number is well stabilized while the number of the germinal areas in the other sections frequently increases to four or five. It may also be noted that the pollen grains of *Conostigma* uniformly exhibit a finely pitted type of sporoderm sculpturing and a vestibule-like modification of the germinal apparatus. On the other hand, in the remaining sections, the sporoderm exhibits various grades of warty outgrowths aligned either in diffuse or in striate fashions.

II. **Evolutionary tendencies**

Evolutionary lines of specialization in the exomorphic characters of the family are presented. On this basis is shown
shown that the section *Conostigma* presents a unique combination of features that is not duplicated in the other three sections. The trends of specialization of endomorphic characters have been elaborated in detail. The features considered involve: primary xylem, secondary xylem, node, petiole, lamina, floral anatomy, pubescence, pollen and crystals. A critical analysis of these trends converges to show that the section *Conostigma* is characterized by a combination of features that is not duplicated in the other sections.

When the trends of specialization of the exomorphie characters and the endomorphic characters are juxtaposed, the section *Conostigma* stands out in relief from the other three sections. Furthermore, it is this section that exhibits a relatively primitive level of structural specialization as compared with the other sections. It is in this section that a combination of relatively primitive and relatively specialized structural features is seen. It is again in this section that the origins of the other three sections are recognized. Thus, section *Conostigma* not only stands apart but also represents a primitive level of evolutionary modification, thus serving as a basic complex within the family.

Considerations as these warrant the taxonomic elevation of section *Conostigma* to the rank of a genus within the same family.

III. Affinities
III. Affinities of the Family

It has been suggested that a final discussion in regard to systematic position of the family would be fruitful only after the presumed allied families of the Alangiaceae are intensively studied. However, an attempt has been made to consider the totality of available evidences in regard to (1) Combretacean alliance and (2) Cornaceae-Nyssaceae alliance. A critical evaluation - to the extent permitted by the available data - appears to strongly negate the Combretacean alliance and it is felt that intensive investigations on the Cornaceae-Nyssaceae complex would perhaps favour the placing of the Alangiaceae as closely related to these families. In view of the large number of exomorphic and endomorphic characters that bind these families together.
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