# CHAPTER - IV

# DISCUSSION

# CHAPTER - 4

## DISCUSSION

In the present study 29 genera belonging to the family Euphorbiaceae have been studied chemotaxonomically. The distribution of various natural products in these genera is presented in Table - 8 . Flavonols formed the dominant phenolic pigments in the family. Alkaloids and saponins are also found to be widely distributed, whereas the iridoids are restricted to only a few members.

Flavonols and saponins predominate the genus Euphorbia. Alkaloids are found to be lesser in occurrence in this genus so also iridoids and tannins. Of the 13 members of genus Euphorbia (including 4 of Chamaesyce) studied the distribution of chemical characters appears to be in agreement with the sectional and subsectional classification of the genus as proposed by pax and Hoffman (1931). The subsection Chamaesyce of section anisophyllum is similar to section poinsettia and thus does not possess a chemical identity of its own. (Table - 13).

The separation of Chamaesyce as a separate genus as proposed by Webster 1967 and Raju and Rao 1977, does not gain any support. The data on chromosome number and morphology (Webster 1967) also do not favour the distinct status of

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| ction | Subsection | Species | Chemical Constituents | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | Flavones/ Flavonols | Alkaloids | Saponins | Tannins | Iridoids | Proanthocyanins |
| | Elegantes | *E.elegans* | Kaempferol | Absent | Absent | Absent | Absent | Absent |
| | Hyperici-foliae | *E.hirta*3 | Quercetin 3'-Ome | Present | Absent | Absent | Absent | Absent |
| | | *E.hypericifolia* | Quercetin<br>Kaempferol | Present | Absent | Absent | Absent | Absent |
| iscophyllum | | *E.heyneana* | - | Absent | Present | Present | Absent | Present |
| | | *E.prostrata* | - | Absent | Present | Absent | Absent | Absent |
| | | *E.coccinea* | Quercetin | Absent | Present | Absent | Absent | Absent |
| | | *E.thymifolia* | Quercetin | Present | Present | Absent | Absent | Absent |
| | | *E.geniculata* | - | Absent | Present | Absent | Absent | Absent |
| | | *E.heterophylla* | Quercetin | Absent | Present | Absent | Absent | Absent |
| insettia | | *E.pulcherrima* | Quercetin<br>Quercetin, 3'-Ome | Absent | Present | Absent | Absent | Absent |

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*Chamaesyce*. Therefore, it is suggested that *Chamaesyce* may be treated as a subgenus within the limits of genus *Euphorbia*.

Moss *et al* (1975), using enriched $C_{12}/C_{13}$ isotope technique ratio determinations also had arrived at similar conclusions. The concept of Euphorbia as a primitive group as suggested by Inamdar and Gangadhara (1977) seems to be in agreement with the available chemical data. The higher percentage of polyploidy (in 40% of members) also indicate the primitive status of this genus.

Inclusion of *Euphorbia* and *Pedilanthus* in the subtribe Euphorbineae of tribe Euphorbieae also do not get much support from chemistry. Karyological (Hans, 1975) as well as palynological (Anand *et al*, 1982) are in agreement with this. The similarities between the genera appear to be a case of parallalism or convergence in evolution.

*Bridelia* and *Cleistanthus* of tribe phyllantheae have been grouped together by Hutchinson (1969), and Pax and Hoffmann (1931). They included various other genera along with *Bridelia* and *Cleistanthus*. Chemical investigation of *Bridelia* and *Cleistanthus* showed the presence of flavonols in both the genera. At the same time other genera grouped under phyllantheae by Bentham and Hooker also possess flavonol of the similar type. Lesser occurrence of alkaloids and more of saponins also are noticed in all the members. Thus the chemical findings does not support the separation of Bridelia and Cleistanthus into a separate tribe Brideliaeae, and also supports Bentham and Hooker's treatment of these two genera along with other genera under tribe Phyllantheae. Inamdar and Gangadhara (1977, 1978) on the basis of trichome and stomatal studies also arrived at similar conclusions.

Phyllanthus, a large genus has been split into various subgenera and subsection by Webster (1956, 1958). Some of these subgenera have already been separated and given generic status e.g. Emblica (Gaertner) and Kirganelia (poiert). All the herbaceous phyllanthus members studied possessed Quercetin & Quercetin 3'-ome while Emblica contained quercetin 4'-ome and tannins. Kirganelia does not contain any flavonoid compound. Saponins and alkaloids were however, present in the genus. Cicca contained both Quercetin 3'-ome and kaempferol 4'-ome and proanthocyanins. On the basis of chemical findings the separation of Emblica, Kirganelia and Cicca from Phyllanthus complex as has been suggested by Webster (1956, 1958) in justified.

Webster (1973) and Anand et al. (1982) showed that Phyllanthus and Breynia have different morphological structure. Hans (1973) reported that Phyllanthus and Breynia have similar chromosomal complexes. The present investigation of Phyllanthus and Breynia showed that both have similar type of flavonol compounds. Moreover, both possessed alkaloids and saponins also. Thus the observation of Hans (1973) on the

| Subgenus | Section | Species | Chemical Constituents |  |  |  |  |  |
|---|---|---|---|---|---|---|---|---|
|  |  |  | Flavone/ flavonol | Alkaloids | Tannins | Saponins | Iridoids | Proanthocyanins |
| Jatropha | Jatropha | J.gossypifolia | Apigenin,<br>Luteolin<br>4'-OMe | Present | - | - | - | - |
|  |  | J.miltifida | Luteolin<br>4'-OMe | Absent | - | Present | - | - |
|  |  | J.podagrica | Apigenin,<br>Luteolin<br>4'-OMe | - | - | - | - | - |
| Curcas | Curcas | J.curcas | Apigenin<br>Vitexin | - | Present | - | - | - |
|  |  | J.ponduraefolia | Luteolin<br>4'-OMe | Present | - | Present | - | - |

Table - 14. Sectional and subsectional arrangement of genus Jatropha on the basis of chemical constituents following Pax and Hoffmann (1931).

placement of *Phyllanthus* and *Breynia* under the same tribe is supported.

Hooker (1887) placed *Jatropha* under subtribe Jatropheae Chrozophora under Chrosophoreae and Acalypha, Mallotus and *Ricinus* under *Acalypheae*. Hans (1973) and Webster (1975) placed *Jatropha* and Chrozophora under different subtribes. Chemical investigation on these genera showed that they should be placed under different subtribes due to the presence of Luteolin 4'-ome in *Chrozophora* as has been done by Hooker. Pollen morphological studies on a number of *Jatropha* and *Chrozophora* members also is in agreement with this view (Anand *et al.* 1961). Dehgan (1980, 1981) studied several species of Jatropha for their epidermal morphology and petiolar anatomy (Table 14 ). All the species examined showed basic paracytic stomata and trilocular 3 trace nodal anatomy. The present investigation showed that there are variations in chemical characters in the genus *Jatropha* which support the division of this genera into sections and subsections as has been done by Dehgan (1980).

Webster (1975) included *Ricinus* under subtribe Ricineae, Acalypha under Acalypheae and *Mallotus* under Rottlerineae. Hans (1973) also indicated that Acalypheae is taxonomically a complex group and on cytological basis comprises many genera having different base numbers. The chemical data obtained in the present study suggests that the subtribe Acalypheae is a complex and unnatural group and should be split up into various subtribes. Webster (1975), Inamdar and Gangadhara (1977, 1978) also supported this view.

Pax and Hoffmann (1931) included Dalechampia and Tragia in the tribe Acalypheae of the subfamily Euphorbioideae under the series platylobeae. Bentham and Hooker (1880) placed these two genera in a separate subtribe plukenetieae of the tribe Crotoneae. Webster (1975) placed Tragia under Tragiinae of tribe plukenetieae and Dalechampia under tribe Dalechampieae.

Chemical investigation showed that both possessed quercetin and kaempferol. Moreover, both had saponins also. Thus the placement of both genera under the subtribe plukenetieae is supported.

## 4.1 Evolutionary trends

Verdus (1976) on the basis of germination studies on 131 species tried to understand and recognise main evolutionary trends in the family. The seedlings were studied with special reference to the shape and size of cotyledons, structure and behaviour of thevascular bundles in the various seedling parts. In correlation to the evolution of the adults (Pax 1924; Pax and Hoffmann 1931; Hutchinson 1959, 1969), it was demonstrated that the morphological seedling characters show a pseudocyclic evolution in the size; that is the very small cotyledonary size of the phyllantheae (primitive) was followed by an increase in size until the "giant Cotyledons of Jatropha curcas (evolved/stage) and by a decrease (over evolved phase,

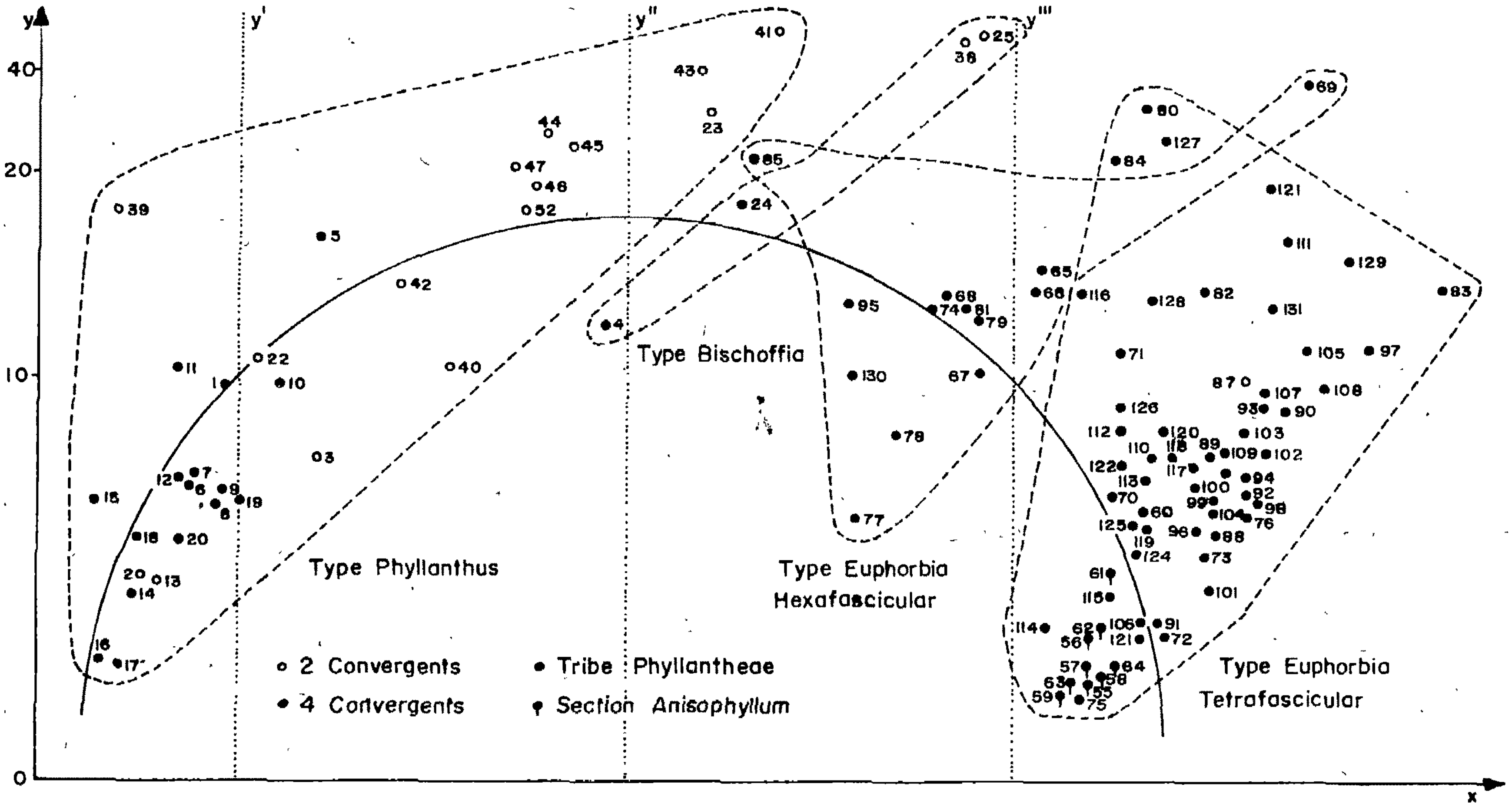

Fig. 2 Pseudocyclic dimensions of cotyledons and vascularisation of seedlings of the family Euphorbiaceae. x axis: larger cotyledons in mm ; axis y, y', y'', y''',: longer cotyledons in mm; xy: axis co-ordinates for the species of type phyllanthus ; xy': axis co-ordinates for the species of type Bischoffia ; xy''axis co-ordinates for hexafascicular Euphorbia type ; xy''': axis co-ordinates for tetrafascicular Euphorbia type.

Euphorbia); this gives an apparent return to the ancestral type. This pseudocycle is correlated with the pseudocyclic avolution of the vascular structures of the seedlings. The Euphorbiaceae begin with 4 hypocotylary bundles (Phyllanthus type) and go to 8 (Bischofia type); later this number decreases to 6 (hexafesciculary Euphorbia type) and finally to 4 (tetrafasciulary Euphorbia type) since other typical examples of pseudocyclic evolution are known, this phylogenetic mechanism seems to have a certain general significance. The Euphorbia seedlings (of the 4 investigated sections) show in their evolution a small pseudocycle in that of the family (Fig. 2-4).

The chemical findings involving 29 genera of Euphorbiaceae do not show a clear cut pseudocyclic evolution. On the basis of the cladistic analysis genus Euphorbia occupies an evolutionary status equal to phyllanthus along with genus pedilanthus. However, the origin of both Euphorbia and Pedilanthus is the same but Pedilanthus takes a different evolutionary line deviating from Euphorbia ultimately attaining the same evolutionary status.

The Euphorbiaceae with its ecological diversity and "the progressive reduction of the flower culminating unexpectedly and very successfully in pseudanthia that are functionally comparable to ordinary flower in other families (Cronquist 1981). Although a convincing Darwinian explenation is not available regarding Euphorbia and Pedilanthus, the taxa can

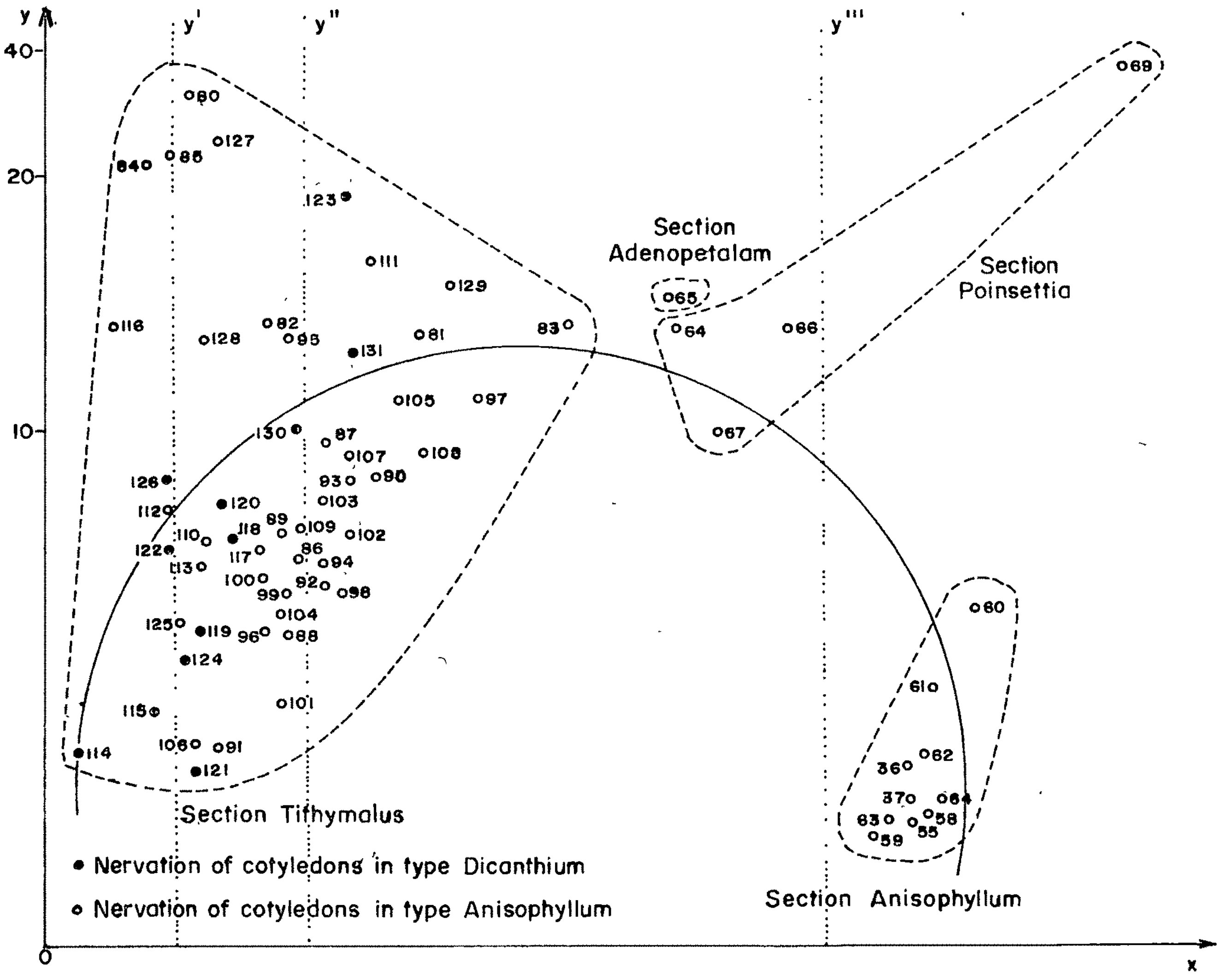

Fig. 3. Pseudocyclic dimensions of cotyledons in the genera Euphorbia Axis x: larger cotyledons in mm; axis $y, y', y'', y'''$: longer cotyledons in mm; $xy$: axis co ordinates for the section Tithymalus; $xy'$: axis is for the section Adenopetalum; $xy''$: axis for the section Poinsettia; $xy'''$: axis for the section Anisophyllum.

be looked upon as shrewd and judicious exploiters of the ambient environment and are very advanced in their reproductive features and at the same time retaining quite a few primitive characters in their seedling morphology and chemistry.

The concept of heterobathmy (Takhtajan 1981) is, therefore, sought to be invoked to explain the evolutionary trends within the family. According to this concept, an organism may present a mosaic of combination of characters of quite different evolutionary level. Thus the Euphorbiaceae shows a mixture of very primitive to very advanced characters within its limits.

Verdus (l.c) also attempted to explain evolution within the Euphorbia. According to him the Euphorbia seedlings showed in their evolution a smaller pseudocycle included in that of the family.

Applying this pseudocyclic concept to understand the chemical evolution of the genus Euphorbia, it is strongly felt that the concept does not provide a true picture of evolutionary trends at least on the basis of available chemical knowledge. Begining with the primitive section Tithymalus there is a progressive chemical evolution through section poinsettia and Euphorbia ultimately ending in section Anisophyllum. The highly evolved Anisophyllum exhibits more of methoxylation and greater

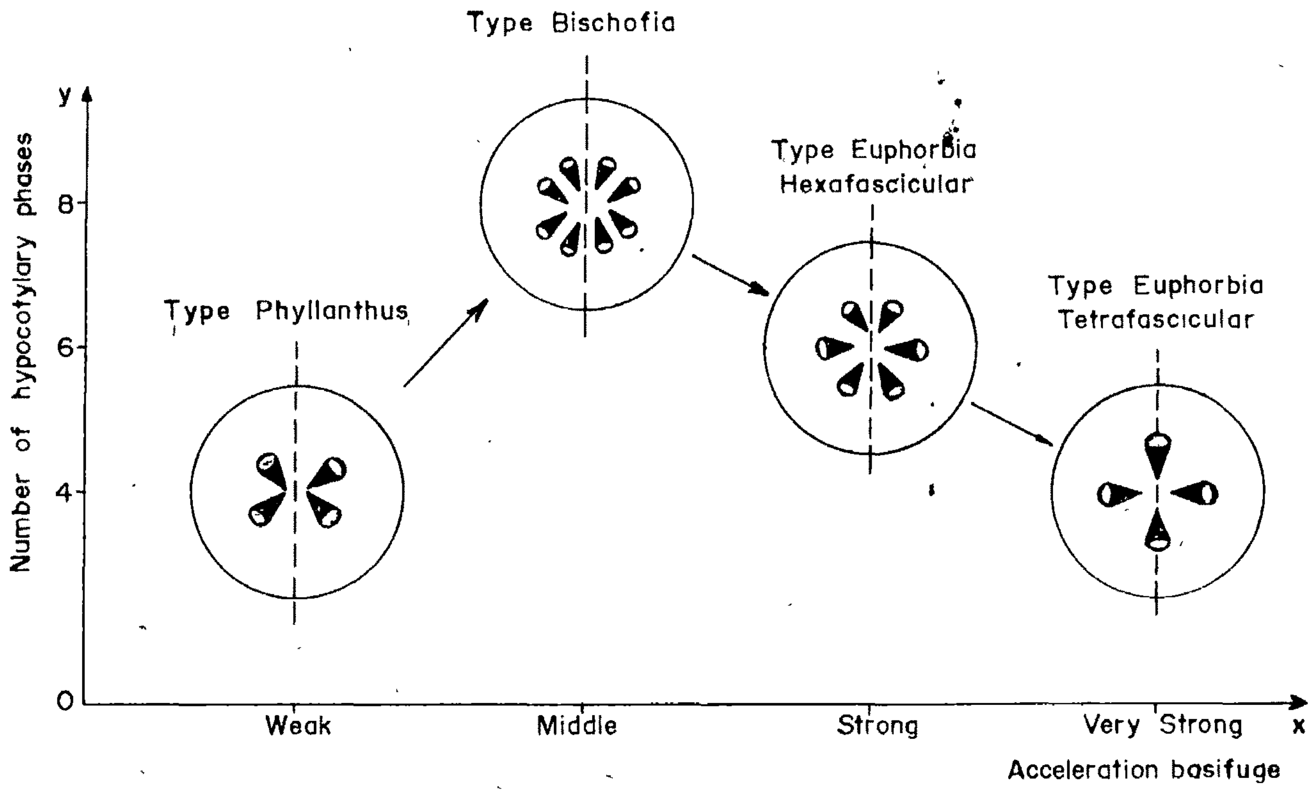

Fig. 4. Plant types of the family in the function of acceleration basifuge. Transverse section of 4 schemes representing the disposition of the phases xylem - phloem in the hypocotyle part. Aspect of pseudocyclic evolution of the vascularisation in plants.

incidence of kaempferol. Recurrence of the primitive chemical character (proanthocyanins) in a single species L.heyneana need not be looked upon as a return to the primitive ancestral type.