EMBRYOLOGY OF THE MAGNOLIALES AND COMMENTS ON THEIR RELATIONSHIPS

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COMMENTS ON FAMILIES

Austrobaileyaceae. The genus Austrobaileya has been included in Magnoliaceae (White, 1933), in Austrobaileyae, as a subfamily of the Dilleniaceae (Croizat, 1940), Monimiaceae (see Bailey & Swamy, 1949), or as a separate family Austrobaileyaceae (Croizat, 1943). According to Bailey and Swamy (1949) the presence of monocolpate pollen, ethereal oil cells, and absence of raphides negate any relationship with the Dilleniaceae. Since this genus has unilacunar nodes, it falls in category A of dicotyledonous families of Bailey and Swamy (1950) and thus has no close affinities with the Magnoliaceae. Bailey and Swamy (1949) remarked that the totality of evidence provides no justification for excluding Austrobaileya from Monimiaceae unless the concept of the family is narrowed to exclude such genera as Trimenia, Piptocalyx, and Amborella (see also Bailey & Swamy, 1948). However, in a subsequent paper discussing the relationships of the Monimiaceae (Bailey & Swamy, 1950) they include this genus in a distinct family, the Austrobaileyaceae, closely related to Monimiaceae.

Magnoliaceae, Degeneriaceae, and Annonaceae. Previously the Magnoliaceae included a number of genera of doubtful affinities like Drimys, Schisandra, Illicium, Trochodendron, Tetracentron, and Euptelea (see Bentham & Hooker, 1862–67;Engler & Prantl, 1887–1909; Hutchinson, 1959; Rendle, 1952). Dandy (1927) has circumscribed the family to include ten genera. Kapil and Bhandari (1964) have compared morphological and embryological characters of Magnoliaceae, Schisandra, and Illiciaceae and supported the removal of Schisandra and its allies to Schisandraceae, and Illicium to Illiciaceae (see also Bailey & Nast, 1948; Gifford, 1950; Lemesle, 1955; Ozenda, 1946; Smith, 1947). Drimys has also been rightly removed to a separate family, the Winteraceae (Bhandari, 1963; Bhandari & Venkataraman, 1968; Dandy, 1933; Smith, 1942, 1943; Van Tieghem, 1900). Similarly the removal of Trochodendron and Tetracentron (Bailey & Nast, 1945; Croizat, 1947; Nast & Bailey, 1945, 1946; Smith, 1945) and Euptelea (Lemesle, 1946; Nast & Bailey, 1946; Smith, 1946) to their representative family has been amply justified. The above conclusions are also corroborated by pollen morphology (Erdtman, 1952).

The family Degeneriaceae was established by Bailey and Smith (1942) and has been recognized as a distinct family of the magnolian stock (see Continued from volume 52, p. 39.)
Eames, 1961), closely related to the Magnoliaceae and Himantandraceae (Bailey, Nast, & Smith, 1943; Swamy, 1949). Hutchinson (1959), however, considers that *Degeneria* is closely related to *Exospermum* and *Zygogynum* and should, therefore, be included in the Winteraceae. Bhandari (1963) has compared the morphological and embryological features of the Winteraceae and Degeneriaceae, and remarked "... *Degeneria* differs from the Winteraceae in many important features like the perianth, stamens, pollen grains, endosperm, embryo, seed coat and floral and vegetative anatomy, and is therefore, rightly placed in a separate monogenic family, the Degeneriaceae (Bailey and Smith, 1942)." Swamy (1949) has concluded that Degeneriaceae, Himantandraceae, and Magnoliaceae are distinct but closely related families.

Bailey *et al.* (1943), Bailey and Smith (1942) and Swamy (1949) have pointed out that Magnoliaceae, Himantandraceae and Degeneriaceae are closely related. Eames (1961), however, maintains that the Annonaceae are most closely related to the Magnoliaceae and the two are perhaps derived from the same ancestral stock, whereas Eupomatiaceae, Himantandraceae, and Degeneriaceae are other families having affinities with the Magnoliaceae. In the absence of any embryological literature on the first two families Kapil and Bhandari (1964) have compared embryological, morphological, and anatomical features of the Magnoliaceae, Degeneriaceae, and Annonaceae and concluded that these families possess many common features such as the tree habit; multilacunar node; bisexual flowers (rarely unisexual in Magnoliaceae); embedded microsporangia; glandular tape-tum with binucleate cells; monocolpate pollen (occasionally acolpate in Annonaceae) in which the generative cell is cut off towards the distal end; anatropous, bitegmic, and crassinucellate ovules; Polygonum type of embryosac with ephemeral antipodal cells; cellular endosperm and follicular fruits. All these features strongly indicate their close relationship. At the same time they differ from each other in some important characters. The stamens are 1-traced in Annonaceae, 3-traced in Degeneriaceae and 3–7-traced in Magnoliaceae. In Magnoliaceae microspores are released from tetrads soon after their formation while they are retained in the tetrad till the differentiation of exine and colpi in the Degeneriaceae and in permanent tetrads in some members of Annonaceae; Ubisch granules are present in Magnoliaceae and not in the other two; the endosperm is ruminate in Degeneriaceae and Annonaceae but not in Magnoliaceae; sarcotesta is present in Magnoliaceae and Degeneriaceae but is absent in Annonaceae; instead a fleshy aril is found which is absent both in the Magnoliaceae and Degeneriaceae; follicles open by a dorsal suture in Magnoliaceae, by a ventral suture in Degeneriaceae, while in Annonaceae follicles become syncarpous in the fruit. The three families differ also in having varied basic chromosome numbers. In Magnoliaceae it is $n = 19$; in Degeneriaceae $n = 12$, while in Annonaceae it varies from $n = 7, 8, or 9$. The family Himantandraceae resembles Degeneriaceae however, in possessing $n = 12$. It is therefore, quite evident that although these families are closely related they cannot be arranged in a linear phylogenetic sequence. They
have some features common to all, others overlapping with either of the families, and still others unique to each one. It may be concluded that they are closely related but distinct families of the magnolian complex.

**Winteraceae.** Bentham and Hooker (1862–67) recognized one genus *Drimys*, and along with *Illicium* placed it in the tribe Winterae of the Magnoliaceae. Van Tieghem’s (1900) was the first extensive survey of the family. He proposed the group Homoxylées to include all the vesselless dicotyledons and Drimyacées to comprise the five genera. *Pseudowintera*, the sixth genus, was added to the Winteraceae by Dandy (1933).

The Winteraceae have unique features such as the trends of specialization of the conduplicate carpel; the primitive stamen; permanent tetrads (elsewhere present only in the Lactoridaceae and Annonaceae) with pollen having the generative cell cut off towards the proximal face; extensive fibrous endothecium, monoporate pollen with conspicuous to minute reticulations; phenolic compounds in the outer epidermis of the outer integument; distinctive endosperm, embryo, and seed structure (see also Bailey & Nast, 1945).

Smith (1943a,b), however, agreed with Burtt (1938) in transferring *Tetrathalamus montana* from the Guttiferae but merged this genus with *Bubbia* as *B. montana* and therefore, recognized only six genera in the Winteraceae. Hutchinson (1959) and Barkley (1966) consider *Tetrathalamus* to be deserving of generic rank and the latter author further favors the recognition of *Wintera* and *Lassonia* (= *Magnolia*, see Willis, 1966) as winteraceous genera. Hutchinson (1959) is of the opinion that *Degeneria*, the monotypic genus of the Degeneriaceae (Bailey & Smith, 1942), is closely related to *Exospermum* and *Zygogynum* and should also be included in the Winteraceae.

Embryological information for *Tetrathalamus, Lassonia* and *Wintera* is lacking and therefore, any discussion pertaining to the taxonomic placement and relationship of these genera must await such data. Bhandari (1963) and Bhandari and Venkataraman (1968) have shown that *Degeneria* differs (Swamy, 1949) from the Winteraceae in many important aspects such as the perianth, stamens, pollen grains, endosperm, embryo, seed coat, and floral and vegetative anatomy, and they support Bailey and Smith (1942) in thinking this genus is rightly placed in a separate family, the Degeneriaceae, and deny any close affinities with the Winteraceae. Bhandari and Venkataraman (1968) considered that *Illicium* differs from the Winteraceae in having vessels in the xylem; unilacunar node; no differentiation in calyx and corolla; endothecium not extending towards the connective tissue; 2-layered glandular tapetum; pollen grains shedding individually, tricolpate pollen; closed sessile carpel; ephemeral antipodal cells; Asterad type of embryogeny; and seed structure. These dissimilarities obviously preclude any possibility of Winteraceae being related to *Illicium* and justify its separation to Illiciaceae (see also Bailey & Nast, 1945; Erdtman, 1952).

Cytologically also the family is distinct. The basic number $x = 13$ in the species of *Drimys* section *TASMANIA* is similar only to that of *Illicium*
floridanum which is however of secondary origin by aneuploidy. No such evidence is available in Winteraceae. Secondly, the section WINTERA of Drimys and Pseudowintera have $n = 43$.

Taking into consideration the sum total of evidence from morphology, vegetative and floral anatomy (Bailey, 1944; Bailey & Nast, 1943a,b; 1944a,b; 1945; Nast, 1944), and embryology (Bhandari, 1963; Bhandari & Venkataraman, 1968; Sampson, 1963; Swamy, 1952), the Winteraceae form a distinct family of magnolian alliance but not closely related to any other existing family.

Myristicaceae and Canellaceae. The Myristicaceae is a homogeneous taxonomic unit. Because of the meager embryological information, not very dependable conclusions can be drawn. Joshi (1946), however, considers that the family is related to Annonaceae, and perhaps the ruminate endosperm and arillate seeds add further support to this conclusion.

The family Canellaceae has also been placed in either Parietales along with Violaceae, Bixaceae, Flacourtiaeae and Koeberliniaceae or in the woody Ranales near Myristicaceae, Illiciaceae, Schisandraceae, and Eupomatiaceae (Engler, 1964; Hutchinson, 1959). Wilson (1960) in a comparative study of wood anatomy concluded that the family is nearly related to Eupteleaceae, Eupomatiaceae, Illiciaceae, and Schisandraceae. Bessey (1915), Vestal (1935), and Wettstein (1935) regarded the families Myristicaceae and Canellaceae as closely related. Although the two families have a number of differences they also possess certain common features such as the simultaneous cytokinesis in the microspore mother cells; the generative cell cut off towards the proximal pole; anatropous, bitegmic, and crassinucellate ovules; Polygonum type embryo sac; ruminate endosperm; paratracheal parenchyma; and uniseriate rays. In both families the rays flare out in the phloem region. Parameswaran (1962) concluded that these two families have a greater degree of resemblance than the remaining families which possess ethereal oil cells, monocarpate pollen, and trilacunar nodes. However, one family cannot be derived from the other. Probably they had a common ancestral stock from which they deviated unidirectionally.

Schisandraceae and Illiciaceae. Most taxonomists, such as Bentham and Hooker (1862–1883), Engler and Prantl (1889–1897), and Rendle (1952) included Schisandra and Kadsura in a tribe, Schisandraceae or a subfamily, Schisandoideae, of the Magnoliaceae. McLaughlin (1933), Whitaker (1933), Lemesle (1945, 1955), Ozenda (1946), Smith (1947), and Bailey and Nast (1948), on the basis of morphology, wood anatomy, and chromosome number, have concluded that Schisandraceae should be raised to family rank as the Schisandraceae. This suggestion has been accepted and incorporated in most taxonomic treatments as that of Lawrence (1951), Hutchinson (1959), and Takhtajan (1966), Thorne (1968), and Cronquist (1968). On the basis of a comparative analysis of morphology, embryological and nodal structure of the Magnoliaceae, Schisandra, and Illiciaceae, Kapil and Bhandari (1964) pointed out that Magnoliaceae differs from Schisandra and Illiciaceae in having undifferentiated stamens with
1 to 7 traces and embedded microsporangia; bilayered glandular tapetum with binucleate cells; Ubisch granules; monocolpate pollen with smooth exine; unilocular ovary with 2 to 6 ovules; vascularized outer integument; testa differentiated into outer fleshy and inner stony regions; multilacunar and multitraced node; stipulate leaves; and \( n = 19 \) as the basic chromosome number; and supported the exclusion of Schisandra and Kadsura to their respective families (see also Kapil & Jalan, 1964). Bhandari and Venkataraman (1968) have shown that embryologically *Illicium* has no affinities with *Drimys* (see also Winteraceae) with which it was associated in the tribe Magnolieae of the Magnoliaceae (Bentham & Hooker, 1862–1868).

Kapil and Jalan (1964) evaluated the morphological, anatomical and embryological features of the Schisandraceae and Illiciaceae. The Schisandraceae possess the following characters in contrast to Illiciaceae: (a) climbers vs. trees or shrubs, (b) eustelic stem with well developed pericycle vs. pseudosiphonostele with poorly developed pericycle, (c) 3-traced unilacunar vs. 1-traced unilacunar node, (d) alternate leaves vs. pseudoverticillate, (e) haplocheilic stomata vs. syndetocheilic, (f) non-pitted sclereids with crystals vs. pitted sclereids without crystals, (g) unisexual vs. bisexual flowers, (h) spirally arranged carpels without style vs. whorled carpels with style, (i) stamens monadelphous vs. stamens free, (j) hexacolpate vs. tricolpate pollen, (k) embryo sac Polygonum, Oenothera or modified bisporic (see Swamy, 1964) type vs. Polygonum type, (l) Onagrad type of embryogeny vs. Asterad type, and (m) fruit a berry with succulent pericarp vs. fruit a follicle with sclerotic pericarp. They (Kapil & Jalan, 1964) concluded that these two families deviate in a large number of characters and there seems to be no close relationship between the Schisandraceae and Illiciaceae as suggested by Whitaker (1933), Smith (1947), and Bailey and Nast (1948). Eames (1961) proposes that Schisandraceae and Illiciaceae, though more specialized, are closely related to the Magnoliaceae and it is possible that all three families probably have been derived from a common ancestral stock. On the other hand, Smith (1947) remarked that *Illicium* has no close allies other than *Schisandra* and *Kadsura*; a conclusion corroborated by the chromosome number of \( n = 14 \). At the same time he emphasized that the two groups have specialized along different lines and have retained certain primitive features. It is impossible to indicate which is the more primitive. Smith’s remarks made about two decades ago, and those of Eames (1961), and Bailey and Nast (1948) seem unfounded in the light of embryological investigations carried out recently. Further, the recent evidence from the karyotypic analysis for Illiciaceae (Stone & Freeman, 1968) and Schisandraceae (Stone, 1968) clearly indicates that Schisandraceae differs from Illiciaceae in having a nearly symmetrical karyotype and lacking subterminal chromosomes. It may very well be that Schisandraceae and Illiciaceae again represent the relics of the extant magnoliales much like many other families such as Winteraceae, Eupteleaceae, and Lactoridaceae.

**Monimiaceae** and allies. The Monimiaceae *sensu lato* included a large
number of genera having doubtful affinities such as *Amborella*, *Austrobaileya*, *Idenburgia*, *Scyphostegia*, *Trimenia*, *Piptocalyx*, *Calycanthus*, and *Gomortega* (see Money, Bailey, & Swamy, 1950).

According to Money *et al.* (1950) *Amborella* has characters resembling those of members of the Monimiaceae such as spiral arrangement of leaves, bracteoles, and tepals; the form and vascularization of the carpels; pollen morphology; fruit morphology; absence of ethereal oil cells; presence of multicellular hairs and hippocrepiform sclereids; and absence of pericyclic fibers in the stem. However, it differs in the orientation of anatropous ovules, narrow rays, and a single arc-shaped leaf trace. Therefore, its position in Amborellaceae, closely related to Monimiaceae, is justified (see also Bailey & Swamy, 1948).

Similarly *Trimenia* and *Piptocalyx* have been removed to a separate family, Trimeniaceae, *Gomortega* to Gomortegaceae, *Calycanthus* to Calycanthaceae and *Austrobaileya* to Austrobaileyaceae and all of these families are interrelated (Bailey & Swamy, 1940, 1949, 1950).

Embryological information on Amborellaceae, Trimeniaceae, and Gomortegaceae is not available, and the embryological literature on Monimiaceae itself is not sufficiently extensive to draw dependable conclusions. However, the Monimiaceae, Calycanthaceae, and Hernandiaceae resemble each other in having the successive type of cytokinesis in the microspore mother cells; periplasmodial tapetum (occasionally glandular in Monimiaceae); anatropous, bitegmic (also unitegmic in Monimiaceae), and crassinucellate ovules; the massive parietal tissue formed by both the primary parietal cell and the nucellar epidermis; multicelled archesporium and functioning of numerous megaspore mother cells; Polygonum type of female gametophyte; and multiple embryo sacs. Such features indicate that these are closely related and form a compact group. As shown by Sastri (1963), all these families also possess affinities with Lauraceae and perhaps with the Lauralian line of Eames (1961), and the theory that they might have had their origin from a common ancestry seems justified. Money *et al.* (1950) also included these families in their group having monocolpate or its derived forms of pollen grains, ethereal oil cells, and unilacunar nodes.

**Lauraceae.** The Lauraceae are relatively advanced over other Magnolian families, and Eames (1961) recognized two phylogenetic lines within the Ranales *sensu lato*, the magnolian line and the lauralian line, the latter including families such as Lauraceae, Hernandiaceae, Myristicaceae, Monimiaceae, and Gomortegaceae. Sastri (1963) has evaluated critically the morphological and embryological data and concluded that Hernandiaceae resembles Lauraceae in having unisexual flowers; stamens with 2-celled anthers and a glandular appendage with vascular supply; periplasmodial tapetum; successive type of cytokinesis; acolpate, 2-celled pollen; two-traced carpel; single anatropous ovule, and similar structure of the seed coat and pericarp; and that therefore, the two families are closely related (see also Shutts, 1960). Similarly Calycanthaceae are closely related to Lauraceae in having periplasmodial tapetum; multinucleate tape-
tal cells; anatropous, bitegmic, and crassinucellate ovules; multicelled archesporium; and Polygonum type of embryo sac. Pollen morphology (Erdtman, 1952) suggests close affinities with Hernandiaceae, Gomortegaceae, and Monimiaceae.

Sastri (1963) has rejected the possibility of any relationship with the Thymeleaceae since the latter family differs in having glandular tapetum with 4-nucleate tapetal cells; simultaneous cytokinesis; multiporate pollen; single-celled female archesporium; and both seed coats persistent. The resemblances, according to him, may be a case of parallelism.

Systematic position of Cassytha. Sastri (1962) has studied the embryology of C. filiformis, C. glabella, and C. pubescens and has found that the genus resembles most other Lauraceae in features such as type of cytokinesis; acolpate, 2-celled pollen; anatropous, bitegmic and crassinucellate ovules; multicellular female archesporium; Polygonum type of embryo sac; formation of seed coat by outer integument alone; and transformation of inner epidermis of pericarp into a stony layer. He (Sastri, 1963) concluded that its retention in the family Lauraceae is proper. However, there are also some important differences: (a) the tip of the nucellus is broad, so that the micropyle formed by the two integuments is very wide, (b) formation of multiple embryo sacs which are haustorial and start invading the nucellus at the 4-nucleate stage, 5 or 6 mature embryo sacs come out of the nucellus and invade even the overarching funicular tissue; (c) the antipodal cells are not organized and the three nuclei are ephemeral, (d) the endosperm is cellular in contrast to nuclear in rest of the family, (e) although the basic plan of seed structure is the same there are some differences in details. On the basis of such important dissimilarities as these, the present author considers that it would perhaps not be too unnatural to remove this genus to a separate family, the Cassythaceae, as proposed by Bartl. ex Lindley (1833) and recently adopted by A. C. Smith (personal communication). Certainly the two families are most closely related and probably derived from the same ancestral stock.

Cercidiphyllaceae and Trochodendraceae. Cercidiphyllum has been variously placed either in the Hamamelidaceae (Baillon, 1871; Croizat, 1947; Hallier, 1903; Lotsy, 1911; McLaughlin, 1933; Solereder, 1900), or in Magnoliaceae (Bessey, 1915; Diels, 1936; Hayata, 1921; Hutchinson, 1959; Lemesle, 1946), in Trochodendraceae (Harms, 1897), or in a separate family, the Cercidiphyllaceae (Cronquist, 1968; Harms, 1918; Takhtajan, 1966; Thorne, 1968). In all these treatments the relationships have been sought with other genera such as Trochodendron, Tetracentron, Euptelea, Hamamelidaceae, and members of the Magnoliaceae. Most recent taxonomists (Cronquist, 1968; Takhtajan, 1966; Thorne, 1968) keep Cercidiphyllaceae in the Hamamelidales. Such embryological features as single-layered glandular tapetum; absence of Ubisch granules; tricolpate pollen with conspicuously broad colpi; 1-celled female archesporium; nucellar cap formed by both the parietal cell and the nucellar epidermis; pattern of early growth of the endosperm. Con-
spicuous basal cell not taking part in the formation of embryo; ovules having vascularized tapering projection, and winged seeds in *Cercidiphyllum* indicate that the Cercidiphyllaceae are not related to the Magnoliaceae.

The chief evidences for including *Cercidiphyllum* either in Hamamelidaceae or in Cercidiphyllaceae placed close to Hamamelidaceae are the presence of stipules, palmate venation, marginal glands, tricolpate pollen, resemblances in wood anatomy to *Corylopsis*, and trilacunar node. The pollen although tricolpate differs basically. Further the resemblances in the wood anatomy may not indicate close relationships with certainty. The wings in the two families differ markedly in histological details (see Swamy & Bailey, 1949). Swamy and Bailey (1949) have taken into account the (i) idioblasts in the leaves, (ii) trends of specialization in the carpels, (iii) pollen grains, (iv) embryology, (v) seed structure, and (vi) wood characters, and they have concluded that the summation of evidence from all organs and parts clearly indicates that *Cercidiphyllum* cannot comfortably be included in any of the existing ranalian families. They agreed with van Tieghem (1900) that it should be placed in a separate family, the Cercidiphyllaceae. They remarked “Nothing is to be gained by transferring such genera as *Tetracentron, Trochodendron, Euptelea*, and *Cercidiphyllum* into close relationship with the Hamamelidaceae or Saxifragaceae, since this would merely serve to expand another order into a less homogeneous assemblage.” To this conclusion I might add that the available evidences from embryology, morphology, anatomy, floral morphology, and cytology suggest that retention of this family within the Magnoliaceae would not make the order more heterogeneous than would its exclusion.

*Trochodendron* along with another primitive genus, *Tetracentron*, has been placed in the Magnoliaceae (Ranales), or in the Hamamelidaceae (Parietales). On the basis of vesselless xylem and primitive type of cambium in both these genera, Nast and Bailey (1945) supported the expulsion of the two genera from the family Hamamelidaceae, or Magnoliaceae and inclusion in separate families of their own, the Trochodendraceae and Tetracentraceae (see also van Tieghem, 1900). Embryology (Yoffe, 1962, 1965) supports this conclusion. Hutchinson (1959) includes *Euptelea* also in the Trochodendraceae. Nast and Bailey (1946), however, believe that *Euptelea* is rightly kept in a distinct family, the Eupteleaceae (cf. Lemesle, 1946).

Embryological information on Eupteleaceae and Tetracentraceae is lacking and any consideration of their interrelationship must await such data. Trochodendraceae and Cercidiphyllaceae resemble each other in having tricolpate pollen; anatropous, bithegmic, and crassinucellate ovules with a tapering chalazal projection; a circumscutaneous vascular bundle which enters the projection, then bends back to end at the base of the nucellus; a single-celled, hypodermal female archesporium; massive parietal tissue; the Polygonum type of embryo sac; cellular endosperm with a similar pattern in early development of endosperm; and a tapering wing
on the seed formed by the chalazal projection. Therefore, these families seem to be more closely related to each other than to any others in the Magnolian complex (see also Yoffe, 1965). On the basis of morphology and anatomy the Trochodendraceae are closely related to the Tetracentraceae (Bailey & Nast, 1945; Nast & Bailey, 1945; Smith, 1945).

Chloranthaceae. Various views have been expressed regarding the interrelationship of the Chloranthaceae, which have been considered related to Santalineae, Ceratophyllaceae, Piperales, or Ranales (see Bessey, 1915; Swamy, 1953; Hutchinson, 1959). Recently Takhtajan (1966) and Thorne (1968) have included the family in Laurales or Annonales respectively, whereas Cronquist (1968) retains this family in Piperales along with Saururaceae and Piperaceae. Vijayaraghavan (1964) has worked out the embryology of Sarcandra irvingbaileyi and evaluated its relationships with either Santalaceae or Piperaeae and Saururaceae. According to him (Vijayaraghavan, 1964) the summation of evidence fails to support any relationship with the families mentioned previously. The Chloranthaceae differ from Santalaceae in including autotrophic plants, with 2-celled pollen; superior ovary with 1 orthotropous bitegmic and crassinucellate ovule; a Polygonum type of embryo sac not developing beyond the ovule; and in lacking endosperm haustoria and having an Onagrad type of embryogeny. The family also differs from Saururaceae and Piperaceae in having unilacunar nodes; pollen with reticulate exine; tetrad of megaspores; and cellular endosperm. No close relationship seems to exist between them. The presence of monocolpate pollen, unilacunar node, and ethereal oil cells point towards ranalian affinities (see also Money et al., 1950). Therefore, this family should be included in the Ranales sensu lato and the Magnoliales sensu stricto.

ACKNOWLEDGMENTS

I am deeply indebted to my teacher, the late Professor P. Maheshwari who initiated me into the field of embryology of the ranalian complex and without whose constant encouragement and inspiration I could not have undertaken the task. I am also grateful to Professor B. M. Johri for his interest and for making possible frequent access to the Maheshwari Memorial Library to consult the literature. My thanks are also due to Dr. A. C. Smith, Dr. A. L. Bogle, and Dr. James Doyle for their valuable comments; and to my colleague Dr. K. M. M. Dakshini whom I approached many times for suggestions and clarifications. I am particularly obliged to my wife for her moral support.

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POSTSCRIPT


In Euptelea polyandra the anther wall is five- or six-layered (epidermis, fibrous endothecium, two or three middle layers, and glandular tapetum with one- to four-nucleate cells). After meiosis the microspore mother cells undergo simultaneous cytokinesis to produce tetrahedral tetrads. At the end of telophase I an evanescent cell plate appears in the equatorial plane. The pollen grains are shed at the two-celled stage. The carpel is peltate, stalked, without a style, and bears a stigmatic crest surrounding a ventral slit, thus resembling that of Schisandraceae, Winteraceae, and Degeneriaceae. The single ovule is pendulous, anatropous, bitegmic, and crassinucellate. Both integuments form the micropyle. The nucellar epidermis divides to form two- or three-layered tissue. The megaspore mother cell cuts off a parietal cell which produces massive tissue, the sporogenous cell becoming deeply buried in the nucellus. A linear tetrad of megaspores is formed, the chalazal one being functional and producing the Polygonum type of embryo sac. The synergids have a conspicuous filiform apparatus; the three uninucleate antipodal cells lie in a small tapering pouch. The endosperm is ab initio cellular; the first few divisions are transverse as in Cercidiphyllum. The embryogeny conforms to the Solanad type.

Endress (1969) concluded that, although Euptelea has its peculiar habit in common with Eucommia ulmoides and Sycopsis sinensis, evaluation of all other characters clearly indicates that it is most closely related to the Schisandraceae and Cercidiphyllum and belongs to the Magnoliales rather than the Hamameli dales.
The reader is also referred to the following recent papers:


**CORRECTIONS**

P. 6, l. 5, for *Pachylarnax phiocarpa* read *Pachylarnax pleiocarpa*.

P. 23, l. 14 from end, for *Laurelia novaezelandiae* read *Laurelia novae-zelandiae*.

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View This Item Online: https://www.biodiversitylibrary.org/item/41808
DOI: https://doi.org/10.5962/p.333904
Permalink: https://www.biodiversitylibrary.org/partpdf/333904

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