February 25, 2010 Number Sixteen

Occasional Papers of the BSG

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Roger W. Sanders

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Occas. Papers of the BSG No. 16, pp. 1-63
www.creationbiology.org

A Quick Method for Developing a Cognitum System Exemplified Using Flowering Plants

ROGER W. SANDERS[1]

[1]*Bryan College, Dayton, TN*

Abstract.
The cognitum, a gestalt-level taxon recognized through human cognitive powers, is a recently introduced taxonomic concept. To apply this concept, a cognitum system of flowering plants is proposed. Human cognitive data were obtained by compiling and comparing the intuitive classifications by five prominent modern but pre-cladistic, pre-molecular authorities. Core group taxa of a cognitum were taken as those in the intersection of the five classifications for that traditional taxonomic group. Those taxa outside the intersection but in the union were assigned to a cognitum's fuzzy boundary, often linking it reticulately to one or more other cognita. More inclusive secondary cognita were formed by majority rule into a partial hierarchy. At the class level, two cognita (monocots and dicots, respectively) were recognized. At the family/order level, 63 cognita were recognized, and at the subfamily/family level, 72 cognita were recognized. The family/order level cognita grouped into 16 secondary cognita, two of which were at the subclass/class level. The family/order level cognita are linked by 264 boundary groups (plus three boundary groups between monocots and dicots). The cognita, while reflecting traditional taxonomic groups, are not equivalent to them or to baramins but rather highlight the mosaic nature of those groups.

Until recently, baraminology has focused on determining limits of created kinds (Wood 2006). The baramin concept (Wood et al. 2003) itself is dependent on the discovery of biological discontinuity among groups of similar organisms. Thus, the baraminological categories (holobaramin, monobaramin, and apobaramin) and methods (similarity/dissimilarity measures, successive approximation) were developed to find the point at which biological continuity gives way to discontinuity (ReMine 1990; Wise 1990; Wood et al. 2003; Wood 2006). However, God endowed different baramins with different degrees of similarity transcending the discontinuities separating the baramins. It is these degrees of similarity that taxonomists traditionally have used to develop higher level classifications.

Presently baraminologists do not understand how baramins relate to one another at higher levels. Wise (1998) argued that, from a biblical perspective, the baramins are not nested in a single hierarchy, a great "tree of life" as assumed in conventional taxonomy. The relationship may be reticulate or even multifarious. To facilitate creationist research into higher-level systematization of baramins and the relationship of design to interbaraminic similarity, Sanders and Wise (2003) proposed the taxonomic concept of the cognitum. In baraminology, the cognitum complements the concepts of mono-, holo-, and apobaramins because, across multiple baramins, it incorporates patterns of similar designs detectable by human cognition. Many of these patterns are recognized by the untrained public, although some patterns require microscopic or technical study. Also, the cognitum is not strictly hierarchical because it incorporates fuzzy-set theory. In conventional taxonomy, some taxonomic groups that are intermediates or mosaics are placed in conflicting positions by different authorities in competing, fully hierarchical conventional classifications. However, in a cognitum classification, these mosaic groups are placed in the fuzzy boundary of two or more cognita and, thus, form reticulations between the clear cut groups or "cognitum core groups" (Figure 1).

Human cognitive data could be obtained in a number of ways. For example, a sample of untrained young adults could be given assortments of plant material and instructions to sort the material according to certain criteria. However, this would require elaborate logistics to obtain sufficient material and to instruct the uninitiated participants. However, there are much more cost-effective ways to estimate the human cognitive response to organisms. The method outlined here is to examine traditional intuitive classifications by well-trained authorities and identify the groups on which they all agree–a consensus classification method, akin to the phylogenetic consensus methods.

The purpose of this paper is to demonstrate the applicability 1) of the cognitum concept to derive a classification system of the angiosperms (i.e., flowering plants) near the family level and above, 2) of the utility of the consensus classification method, and 3) of the significance of a cognitum system for creationist implications.

METHODS

Human Cognitive Data. Five classifications by

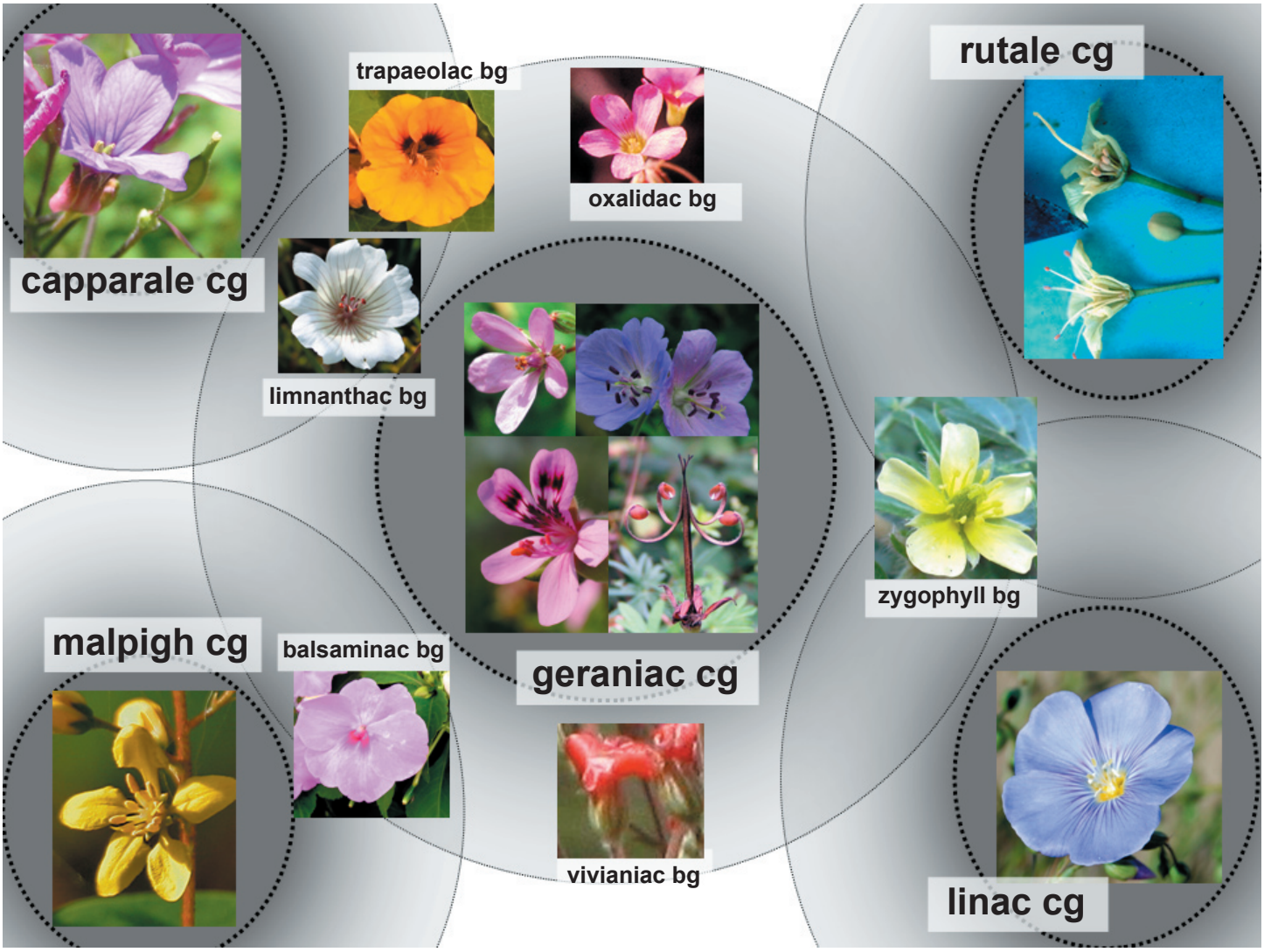

Figure 1. Fuzzy set Venn diagrams illustrating the cognitum concept using the geraniac cg (corresponding to the conventional Geraniaceae), its core group (tribe Geranieae), some of its boundary groups, and the adjacent cognita linked to the geraniac cg via some boundary groups. Core groups within heavy dotted lines, cognitum boundary between heavy dashed and light dotted lines. Oxalidac and vivianiac boundary groups do not act to link other cognita to the geraniac cg. The zygophyll bg is in the intersection of three cognita, linking all three. Photos by author: **balsaminac bg** (*Impatiens holstii*); **oxalidac bg** (*Oxalis sp.*, Toluca, Mexico); **capparale cg** (*Lunaria annua*); **rutale cg** (*Harpullia arborea*). Photos from Wikipedia: **gereniac core group**, clockwise from lower left, *Pelargonium graveolens*, *Erodium cicutarium*, *Geranium pratense*, *Geranium sanguineum* fruit; **limnanthac bg**, *Limnanthes douglasii*; **tropaeolac bg**, *Tropaeolum majus*; **vivianiac bg**, *Viviania marifolia*; **zygophyll bg**, *Tribulus terrestris*; **linac cg**, *Linum lewisii*; **malpigh cg**, *Galphimia gracilis*.

authoritative botanists (Melchior 1964; Dahlgren 1975; Thorne 1976; Tahktajan 1980; Cronquist 1981) were chosen to provide cognitive groupings determined by humans with extensive familiarity with flowering plants. While there are other general classifications of angiosperms (see Takhtajan 1980; for example Goldberg 1985, 1989), these five were chosen for several reasons.

1. These classifications were published between 1964 and 1981, thus representing the pinnacle of the intuitive method of biological systematics by authorities who had spent their lives observing the spectrum of plant diversity. In particular, by the mid-twentieth century anatomical studies had elucidated errors of presumed relationship that false assumptions had forced on early attempts at phylogenetic classification in the 60 years after Darwin's *Origin of Species*. The period in which the classifications employed here were published was also prior to the dominance of computational, cladistic, and molecular methods that recently have radically altered classifications.

2. Other classifications were not chosen because they are rarely referenced and, hence, not considered authoritative, or they were developed for special contexts (e.g., Young & Seigler 1981), or are founded on nearly universally rejected assumptions

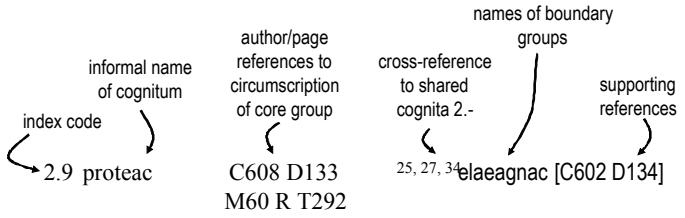

Figure 2. Example of data comparing classifications. This represents a sample from columns 1-3 of Appendix A. In column 1, "index code" 2.9 stands for Dicot–cognitum 9. In column 2, the upper case letters stand for the classifications mentioned in the text with page cited as follows: C=Cronquist, D=Dahlgren, M=Melchior, R=Thorne, T=Takhtajan. For "cross-reference to shared cognita" in column 3, the numbers indicate other cognita in which the boundary group occurs and that are, thus, linked with this cognitum. The index codes are abbreviated by deletion of the first number and decimal because in each case these are identical to those of the core group. For naming of core and boundary groups, see text.

(e.g., Hutchinson 1973), or are superficial adaptations of one of these or other classifications for textbooks (e.g., Benson 1979; Stebbens 1974).

3. Even though Dahlgren and Thorn modified their classifications later, the earlier versions used here are free of these modifications that they based on the cladistic literature or from discussions with botanists critical of their earlier versions.

4. Each of the five authors offers different perspectives on how classification principles are applied, which characters are emphasized, and which are the presumed ancestors. In particular, Melchior's classification is a modern revision of Adolf Engler's sequence (arising from Engler's famous, multi-decade encyclopedic work, *Die natürlichen Pflanzenfamilien,* Engler & Prantl 1887-1915) that assumes a conifer-gnetophyte ancestor of angiosperms. The other four assume a pteridosperm ancestor.

Evaluation of Cognition and Circumscription of Cognita. The common cognitive response of the five authors to each plant group was determined as the constituent taxa found in the intersection of the five classifications for that plant group. Thus, the taxa recognized in all five classifications as constituting a particular traditional taxonomic group were designated as the core group of the cognitum (see Sanders & Wise 2003) corresponding to that traditional taxonomic group. The remaining taxa that one or more of the authors placed in other taxonomic groups (i.e., hence, outside the intersection) were considered to be parts of the fuzzy boundaries of all cognita involved. Taxa recognized as constituent by some authors and segregated as an equivalent monotypic taxonomic group by other authors were assigned to the fuzzy boundary of only the one cognitum. Also assigned to the fuzzy boundary were small anomalous taxa that all authors segregate but disagree as to affinities with taxa treated here as cognita. Thus, the cognitum consists of both the core and the boundary. The data used to recognize, i.e., circumscribe, the cognita were entered in columns 1 to 3 of Appendix A, of which one entry is shown in Figure 2 as an example.

Formation of Partial Hierarchy using a Consensus Classification. Because the taxa that are contentious in the traditional classifications generally are assigned to two or more cognita, it is impossible to place all known taxa in an exhaustive hierarchy. However, a partial hierarchy can be obtained by grouping cognita (from this point considered "primary" cognita) into more inclusive cognita (secondary cognita) by majority rule among the traditional classifications (i.e., agreement among three, four, or five of the classifications). Not only do the boundary groups form links among primary cognita but also the alternate placement of primary cognita in secondary cognita (suggested by the minority classifications) form links among secondary cognita. Both forms of disagreement reticulate the hierarchy. Data used to circumscribe secondary cognita are summarized in Table 1.

Generally the primary cognita at the subfamily/family level nested within the primary cognita at the family/order level. For cases in which authors disagreed about the association of the former with the latter, a compromise cognitum (i.e., a semi-primary cognitum) was recognized. That is, placing primary cognita in the boundary of nearly equivalent cognita would lead to inconsistency. I relied on my own familiarity with the plants, as well as a consensus of more recent authors (see Table 1).

Informal Nomenclatural Conventions Used Here for Cognita. Formal nomenclature rules have not been formulated to regulate consistent naming of cognita. However, to provide informal names of the cognita and associated boundary groups for this paper, several conventions were used.

1. The name of the cognitum and boundary groups combine an adjectival word with either "cognitum" or "boundary group", which can be abbreviated "cg" and "bg" respectively.
2. The adjectival word of the name is derived from the Latin name that has been applied to the conventional taxonomic group that approximates the cognitum.
3. Latin names based on the root of a genus name is Anglicized by modifying the rank suffix as follows:
   a. Subfamily: -oideae → -oid
   b. Family: -aceae → -ac (if root ends in "c" or "ch", then → -ad)
   c. Order: -ales → -ale
   d. Superoder: -anae → -an (alt.: -iflorae → -iflore)
   e. Subclass: -idae → -id
4. A Latin name based on a descriptive term is preferred when available, as it denotes a character easily assimilated into the rapid recognition of the group. Such names usually end in "ae", and this ending is dropped and the word appropriately modified into an adjective (Helobiae → helobial) or the traditional common name derived from the Latin word is used (e.g., Compositae [i.e., the allowed alternative descriptive name of the Asteraceae]→ composite).
5. In cases with common names that are widely used by botanists and horticulturists, these names are used (e.g., aroid for Araceae, bromeliad for Bromeliaceae, cyclanth for Cyclanthaceae, etc.).
6. Long names (four or more syllables by following conventions 2-4 above) were abbreviated by shortening to roots that ended in "-ad", "-anth", "-carp", "-er", "-ll", or "-sperm." Roots ending in "-gin" are shorted to

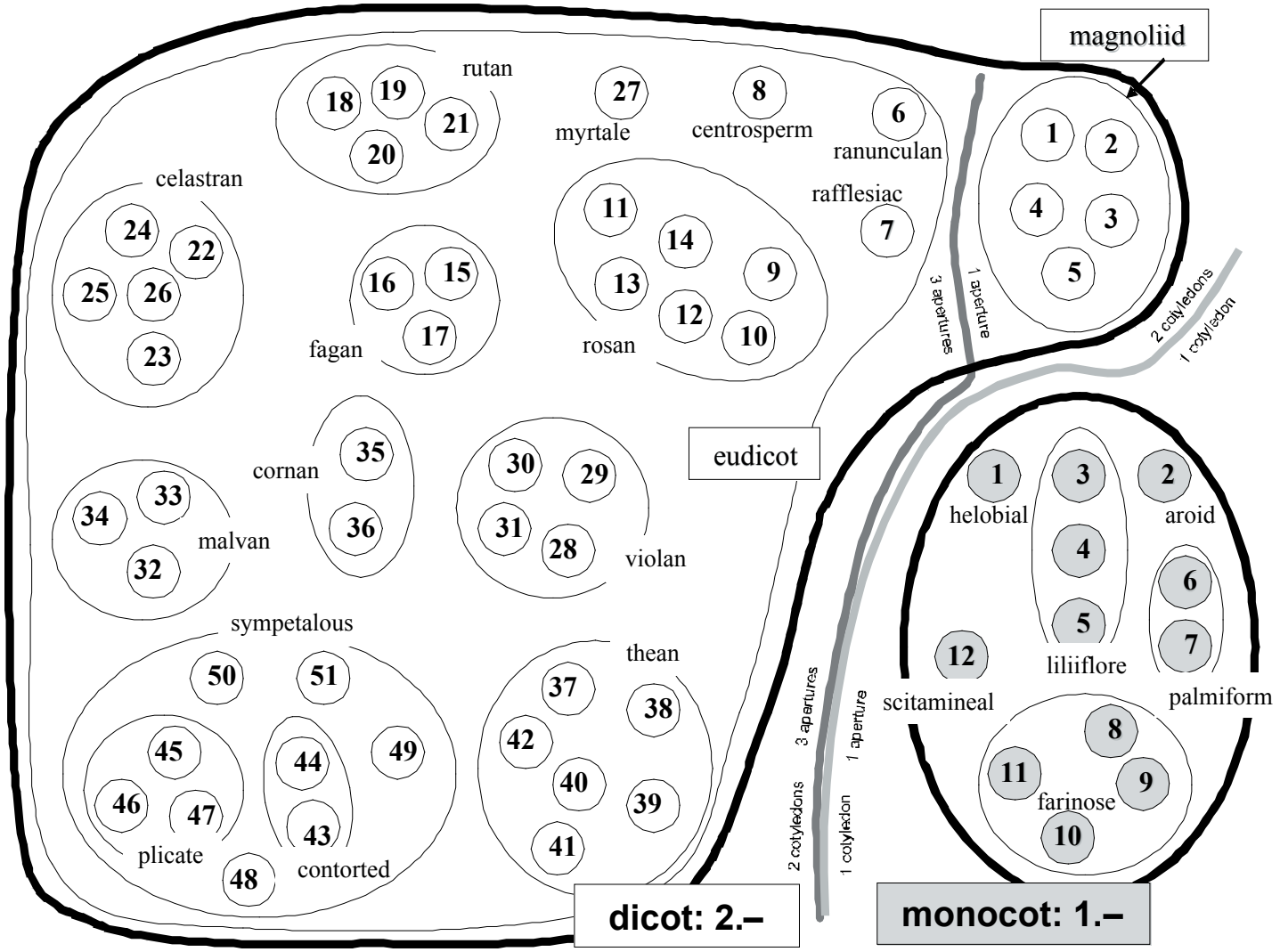

Figure 3. Diagram of consensus classification and cognita, summarizing the partial hierarchy of the core groups of the 63 family/order level primary (and semi-primary) cognita plus the monocot and dicot cognita and intermediate level secondary cognita. The index codes of primary cognita are indicated by the circled numbers which correspond to the numbers to the right of the decimal of the respective monocot or dicot cognita in Table 1 and Appendix A. Dividing lines indicate contradictory distribution of sets of homologous character states that delineate the monocots from the magnoliid dicots and eudicots. See text for further discussion.

"-ge" in parallel with the common name "borage" for Boraginaceae.

7. Where no existing name corresponds to a newly formed secondary cognitum, an English adjective is used, taken from a descriptive feature.
8. Other names are genus names used as common names in cases where the genus has not been elevated to tribe or higher rank but is noted as intermediate.

RESULTS

Table 1 summarizes the resulting consensus cognitum classification. Sixty-three family/order level cognita are designated in the flowering plants (Figure 3). Of these, 15 are composed of smaller cognita at the subfamily/family level. The total number of such included cognita is 72, bringing to 135 the total subfamilial to ordinal level cognita (Table 1, Appendix A). There are only two primary cognita above the family/order level, the monocot and dicot class level cognita. The monocot cognitum contains 12 family/order level cognita (index numbers 1.1-1.12) and 23 subfamily/family level cognita. The dicot cognitum contains 51 family/order level cognita (index numbers 2.1-2.51) and 49 subfamily/family level cognita. Because the majority-rule (secondary) cognita were intercolated after the primary cognita were determined and assigned index codes, they are not assigned index codes. To assist the reader in understanding and visualizing the cognitum core groups, technical delimitation by reference to traditional taxon equivalents, citations of diagnostic illustrations, and telegraphic descriptions of each are given in columns 4 and 5 of Appendix A. Also the secondary cognita are illustrated in Appendix B, Figures B1-B13.

Included among the 63 family/order level primary cognita are 11semi-primary (i.e., compromise primary) cognita—the

Table 1. Consensus classification and summary of angiosperm cognita[1]

Core group ID	Classification and cognitum adjectival names	Divergence from majority rule of semi-1° & 2° cognita	No. 1° Cogn.	Boundary groups occurrences	Core ID sharing boundary groups.
1	monocot		1	3	2
1.1	helobial		4	2	1.4
1.2	aroid	-C	1	3	1.6, -8, -9
	liliiflore	+ bromeliad D, + cyperac T	-	-	
1.3	dioscoreac		1	2	1.4, -8
1.4	lilian	a	12	8	1.1, -5, -8, -10*, -11
1.5	orchid	-M	1	3	1.4
	palmiform	+ typhac T, + aroid C	-	-	
1.6	pandan	-M	1	2	1.2, -7, -9
1.7	palm		1	1	1.6
	farinose	-M, + typhac C, + scitamineal R, - cyperac T	-	-	
1.8	bromeliad	-D	1	5	1.3, -4, -10*, -11
1.9	typhac		1	2	1.2, -6
1.10	graminioid	b	4	5	1.11
1.11	commelinale	c	4	7	1.4, -8, -10
1.12	scitamineal	-R	4	0	
2	dicot		1	3	1
	magnoliid or monoaperturate dicot	+ ranunculan CMR, + rafflesiac T	-	-	
2.1	magnoliale		5	10	2.2, -3, -15, -37
2.2	laurale		1	5	2.1, -3
2.3	piperale	-M	1	2	2.1, -2
2.4	aristolochiac	-M	1	1	2.7
2.5	nymphaeale		1	3	2.6
	eudicot or triaperturate-dicot		-	-	
2.6	ranunculan	-C, -M, -R, d	5	4	2.5, -18
2.7	rafflesiac		1	2	2.4
2.8	centrosperm	- cactus M	9	5	2.18*, -30, -42
	rosan	+ hamamelidale M	-	-	
2.9	proteac	-C (but see p. 524, 602)	1	1	2.25, -27, -34

Table 1. Continued.

Core group ID	Classification and cognitum adjectival names	Divergence from majority rule of semi-1° & 2° cognita	No. 1° Cogn.	Boundary groups occurrences	Core ID sharing boundary groups.
2.10	hydrangeoid	-D	1	35	2.11, -12, -13, -14, -15, -16, -17, -18, -21, -22, -24, -27, -28, -29, -32, -35, -36, -41, -46, -48, -50
2.11	saxifragoid	-D (but see p. 124)	1	23	2.10, -13, -18*, -21, -27, -28, -29, -35, -37, -39, -41, -46, -49, -50
2.12	cunoniac	-D	1	12	2.10, -13, -14, -18, -22, -27, -35, -37, -43
2.13	rosac		1	10	2.10, -11, -12, -14, -18, -19, -34, -37
2.14	legume	-C (but see p. 588)	1	2	2.10, -12, -13, -18, -22
	fagan	+ urticale CT, +cunoniac D	-	-	
2.15	hamamelidale	-M	1	17	2.1, -10, -16, -17, -18, -22, -32, -33, -35,
2.16	fagale		1	5	2.10, -15, -17, -18, -33
2.17	casuarinac	-M	1	6	2.10, -15, -16, -18, -22, -32
	rutan	+ euphorb M	-	-	
2.18	rutale	e	5	15	2.6, -10, -12, -13, -14, -15, -16, -17, -19, -20, -22, -32, -33
2.19	geraniac	-C (but see p. 524, 823), -R	1	11	2.13, -18, -20, -21, -30
2.20	linac	-C, -R	1	7	2.18, -19, -21, -28, -37
2.21	malphig	-C, -R	1	8	2.10, -11, -14, -18*, -19, -20, -30
	celastran	+ rafflesiac CR, + euphorb C, + oleac R	-	-	
2.22	celastrac		1	23	2.10, -12, -15, -17, -18, -22, -23, -24, -30, -32, -33, -35, -41, -44, -45, -48*
2.23	aquifoliac	-R	1	7	2.22, -24, -35, -37, -45
2.24	santalale	-M	1	6	2.10, -22, -23, -27, -28, -35, -41
2.25	rhamnac	-R	1	2	2.9, -26, -27, -34

Table 1. Continued.

Core group ID	Classification and cognitum adjectival names	Divergence from majority rule of semi-1° & 2° cognita	No. 1° Cogn.	Boundary groups occurrences	Core ID sharing boundary groups.
2.26	vitac	-R	1	1	2.25
2.27	myrtale		6	15	2.9, -10, -11, -12, -24, -25, -32, -34, -35, -37, -43, -48
	violan		-	-	
2.28	violale	f	7	18	2.10, -11, -16, -20, -24, -29, -30. -34, -37, -38, -40, -46, -47
2.29	cucurbitale	-M	1	3	2.28
2.30	capparale	-M, -T	1	10	2.8, -18*, -19, -21, -22, -28, -44
2.31	loasac	-D, -T	1	0	
	malvan	+ rhamnac R, + convolvulale R, + campanulac R, +polemoniac R	-	-	
2.32	euphorb	-C, -M	1	13	2.10, -15, -17, -18, -22, -27, -28*, -33, -34
2.33	urticale	-C, -M, -T	5	4	2.15, -16, -18, -22, -32, -35
2.34	malvale		1	14	2.9, -13, -25, -27, -28, -32, -37, -40
	cornan	+ dipsacale R, +vitac R, +ericale D, +sarraceniac D	-	-	
2.35	cornale		1	25	2.10, -11, -12, -15, -22, -23, -24, -27, -33, -36, -48, -49,.-50
2.36	umbellifer	-C, -D	1	3	2.10, -35
	thean	+ violan CMT, + malvale C	-	-	
2.37	theoid	g	1	37	2.1, -11, -12, -13, -20, -23, -24, -27, -28, -34, -38, -39, -40, -41
2.38	guttifer		1	2	2.28, -37
2.39	sarraceniac	-D	1	2	2.11. -37
2.40	sapotale	-D	1	8	2.18*, -28, -34, -37, -47
2.41	ericale	-D	1	11	2.10, -11, -22, -24, -37
2.42	primulale	-D	1	5	2.8

Table 1. Continued.

Core group ID	Classification and cognitum adjectival names	Divergence from majority rule of semi-1° & 2° cognita	No. 1° Cogn.	Boundary groups occurrences	Core ID sharing boundary groups.
	sympetalous	+ sapotale M, + ericale M, + primulale M	-	-	
	contorted	+ dipsacale DT, + loasac T	-	-	
2.43	gentianale	h	5	3	2.12, -27, -45, -48, -51
2.44	oleac	-C, -R	1	2	2.22, -30, -48*
	plicate	-M	-	-	
2.45	convolvulale	i	3	3	2.22, -23, -43, -45*, -51
2.46	polemoniac		1	2	2.10, -11, -28, -47
2.47	borage	-C (but + on p. 920), j	1	4	2.28, -40, -46
2.48	bilabiate	i, j, k	9	7	2.10, -27, -35, -43
2.49	dipsacale		1	3	2.11, -35, 50, -51
2.50	campanulac		1	7	2.10, -11, -35, -49, -51
2.51	composite		1	1	2.49, -50
Totals	**65 (63 fam/ord level) 1° & semi-1°**		**137**	**471**	

[1]Under "Divergence from majority rule of semi-1° & 2° cognita" the upper case letters stand for the classifications mentioned in the text as follows: C=Cronquist (1981), D=Dahlgren (1975), M=Melchior (1964), R=Thorne (1976), T=Takhtajan (1980); a minus sign by a primary cognitum indicates that an author either did not accept it at the hierarchical rank indicated by the indention or else placed it in different inclusive group, whereas the author's inclusion in a secondary cognitum is indicated by a plus sign. "No. 1° Cogn." counts both the named primary cognitum and any included ones at lower rank.

Notes to explain semi-primary cognita as follows: **a**: R excludes irid cg and pontederiac cg; T associates smilacoid cg and trillioid cg with dioscoreac cg. **b**: T associates the juncad cg and cyperac cg with the liliiflore cg; R disassociates grass cg from juncad cg and cyperac cg; M disassociates all three. **c**: R disassociates xyrid cg from the commelinale cg. **d**: M associates nymphaeale cg with and excludes papaverac cg from ranunculan cg. **e:** D and M disassociate anacardiac cg and sapindac cg from rutale cg; M associates malpighiac cg with rutale cg; T is somewhat ambivalent; clearly all the pinnate, alternately leaved, nonstipulate included cognita of rutan cg are recognizably more similar to each other than any is to the simple-leaved families. **f**: D associates cucurbitac cg with violale cg; M associates salicad cg with fagale cg. **g:** R associates the aquifoliac cg with the theoid; D associates clusiac cg with the theoid cg. **h**: C associates the rubiac cg with the dipsacad cg and composite cg as a taxon of equal rank. **i**: M and T associate the solanac cg with the bilabiate cg; M associates the polemoniac cg with the bilabiate cg; T also associates the plicate cg with the bilabiate cg; D associates the polemoniac cg and borage cg with the convolvulale cg. **j**: R later modified to this hierarchy from that in which borage, labiate, and verbenoid cognita are combined; C maintained the combined group of borage, labiate, and verbenoid cognita. **k**: the most obvious recognizable trait, two-lipped flowers, is mostly overshadowed by other traits in traditional classifications noted in **i** and **j.** (see Wagenitz 1977).

In last column, an asterisk (*) indicates "only in the boundary of an included primary cognitum of the core group identified."

lilian, graminoid, commelinale, ranunculan, rutale, violale, theoid, gentianale, convolvulale, borage, and bilabiate cognita (Table 1, Appendix A). In all cases, the dissenting author positioned the group to support a pet theory of evolutionary ancestry based on undue weighting of one or a few characters (e.g., tepal-like scales and embryo embedded in endosperm of Cyperaceae, inferior ovary of Rubiaceae, and fused stigma pair of Solanaceae). However, each of the corresponding semi-primary cognita is characterized by suites of vegetative and reproductive characters that unequivocally speak to a common gestalt of its members. In some cases, the authors later modified their classifications to correspond with that chosen here. In particular, the unity of the bilabiate cognitum has been overshadowed by the undue significance given nutlet fruits of Boraginaceae, Labiatae (=Lamiaceae), and Verbenaceae despite the immediately similar gestalt of the two-lipped flowers of the Labiatae and Verbenaceae to the other bilabiate families. Contemporaneous with the authoritative classifications, Wagenitz (1977) highlighted a suite of characters that further correlate with the two-lipped recognizability gestalt. Indeed, the Labiatae and Scrophulariaceae (i.e., antirrhinoid cg, 2.48.7) are often confused by novices who do not carefully examine the developing fruits.

Consensus classification of the angiosperms (Figure 3). The conventional monocotyledonous class (Monocotyledoneae, Liliopsida, or "monocots" of most authors) is upheld as a higher level primary cognitum. However, the conventional dicotyledonous class (Dicotyledoneae, Magnoliopsida, or "dicots" of most authors) is problematic. All five authors place all remaining angiosperms in the dicots. However, four either explicitly or implicitly hold that the monoaperturate dicots (pollen has one germination pore) are the remnants of the ancestors of both the triaperturate dicots and monocots (Melchior 1964, p. 498; Thorne 1976, p. 98) or that the Nymphaeales (of the monoaperturate dicots) share a common ancestor with the monocots (Cronquist 1981, p. 1034; Takhtajan 1980, p. 236) (see Figures 3, 4). Dahlgren (1975) does not comment on the theories. In both cases, their classifications contradict their understanding of the groups and show a reliance on the single character of cotyledon number. In pointing out the supposed phylogenetic connections between the monoaperturate dicots and the monocots, they all emphasize the similarity in the pollen between the two groups. Subsequent studies by many workers using both morphological and molecular datasets have confirmed that cotyledon number and pollen aperture number are among the few characters that can be homologized across the whole of the angiosperms (see Figure 3).

From a cognition standpoint, both the number of cotyledons and number of pollen apertures are characters that do not contribute greatly to the "gestalt" of individual plants. In the eudicot cg and monocot cg, these traits are correlated with suites of characters, respectively, that *do* contribute to the gestalt, such as growth patterns, stem architecture and texture, leaf venation and shape, leaf surface texture and gloss, flower-part numbers, and fruit structure—things one would notice when mowing the lawn, making a bouquet, or chopping vegetables for a meal. In the monoaperturate dicots, however, these traits occur to varying degrees as mosaics of typical dicot and monocot characters. For example, the piperale cg and nymphaeale cg have monocot-like stems, and some of the nymphaeale cg have flowers very similar to those of monocots. Even the magnolian cg and laurale cg, which have leaves and woody growth typical of dicots, have petal-structures in multiples of threes as in monocots. Likewise a few monocots (e.g., dioscoreac cg and smilacoid cg) approach dicots (especially the piperale cg) in leaf structure (Burger 1977; Inamdar et al. 1983; Taylor & Hickey 1990).

Therefore, to incorporate the authors' views on connections between the monoaperturate dicots and monocots in the consensus classification, I have recognized the former as a secondary cognitum. Thus, the dicots are broken into a magnoliid secondary cognitum (Appendix B, Figure B1) with 5 constituent primary cognita and a triaperturate dicot secondary cognitum (often refered to in the literature as "typical dicots" or "eudicots") of 46 primary cognita. Forty-two of these cluster into 11 order/subclass level secondary cognita (see below). Alternatively, one could recognize a dicot cognitum of 46 primary cognita with the five magnoliid cognita relegated to the fuzzy boundary between the dicot and monocot cognita.

With regard to the majority consensus that the ranunculan cg belongs in the magnoliid cg (by three of the five authors, see Figure 4), similar reasoning is applied. Even though Cronquist (1981, p. 117) places the Ranunculales in the Magnoliidae, he notes the anomaly of its pollen. Therefore, I consider the majority consensus as compromised, and the ranunculan cg must be placed as an independent group in the eudicot cg

Within the monocot cg there appear to be six hierarchically equivalent cognita: the helobial, aroid, and scitamineal primary cognita and the liliiflore, palmiform, and farinose secondary cognita (Appendix B, Figures B2-B4). The dicot cg consists of two high-level secondary cognita (i.e., the magnoliid cg and the eudicot cg). The magnoliid cg contains no higher groups other than its five order/family level primary cognita. The eudicot cg comprises 13 higher-level cognita: the ranunculan, rafflesiac, centrosperm, myrtale primary cognita and the rosan, fagan, rutan, celastran, violan, malvan, cornan, thean, and sympetalous secondary cognita (Appendix B, Figures B5-B13). The sympetalous secondary cognitum consists of two subsets of primary cognita, these two being the contorted and plicate secondary cognita, respectively.

The degree to which the consensus classification differs from the five traditional classifications is shown in Figure 4. Each dissenting placement is indicated by a line from the cognitum in the consensus classification to the position it would be if placed according to the dissenting classification, either within a higher-level secondary cognitum or united with another primary cognitum.

Disposition of Boundary Groups (Figure 5). When all 137 primary (and semi-primary) subfamily to class level cognita are considered, minor or otherwise anomalous families and subfamilies or single intermediate genera constitute 386 boundary groups that appear in 751 occurrences (Appendix A). When the 72 subfamily/family level subsidiary primary cognita are excluded (as in Table 1 and Figure 5), the number of boundary groups and occurrences is still significant—267 and 471, respectively. For the 63 family/order level cognita, the average number of boundary occurrences per cognitum is 7.3 with two isolated cognita (scitamineal, 1.12, and loasac, 2.31) lacking

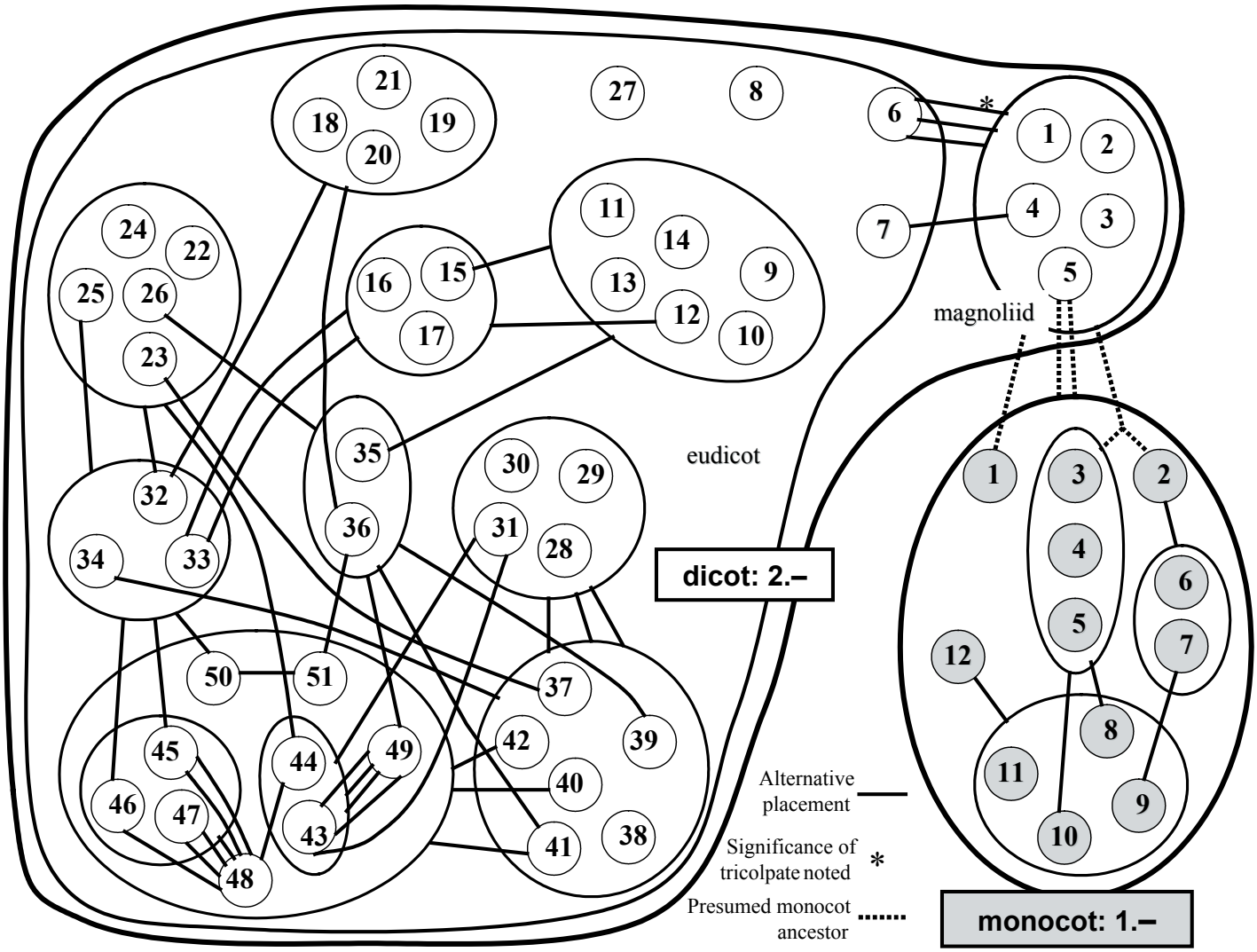

Figure 4. Diagram showing divergence of opinion among the traditional classifications. Solid lines connect a cognitum to a higher level cognitum in which the particular dissenting author places it. A line connecting two primary cognita indicates that the author would submerge the two into a single group. An asterisk (*) indicates the placement is contradicted by the author's discussion of the pollen-aperture character. The dashed lines indicate the strong similarities between monocots and magnoliid dicots that lead four authors to suggest ancestry for monocots out of the magnoliids, thus, contradicting the authors' own positioning of the magnoliid cognitum as part of the dicot cognitum.

boundary groups and the theoid cg (2.37) having a remarkable 37 groups in its boundary. Both monocot and magnoliid cognita average about 4 boundary occurrences per cognitum, whereas the eudicot cognita average over 8 occurrences per cognitum. To assist the reader in understanding and visualizing the cognitum boundary groups, technical delimitation and published diagnostic illustrations of each are listed in Appendix C.

DISCUSSION

Relationship of cognita to baramins and traditional taxa. On the surface, it might appear that this cognitum system is just a simplified version of traditional classifications. Actually it differs significantly in several respects.

1. The cognita are not based on explicit or implicit comparisons of characters or biometric distance measures but on the gestalt of the plants and the classification response it elicits in humans.
2. The controversial taxa are "missing" from the hierarchy because they occur in the fuzzy boundaries of multiple cognita.
3. The cognita are reticulately linked by alternate placements (by authorities, or potentially alternate sortings by laymen) and by groups in the cognita's fuzzy boundaries.
4. The cognita are founded only on the core of constituent taxa of the corresponding traditional inclusive taxa.
5. The cognita represent a cognitive response by the authorities. Granted, the response has been filtered through their extensive knowledge of published comparative research. However, it is based on the authorities' weighing the published data against their own visual and tactile familiarity with the plants.

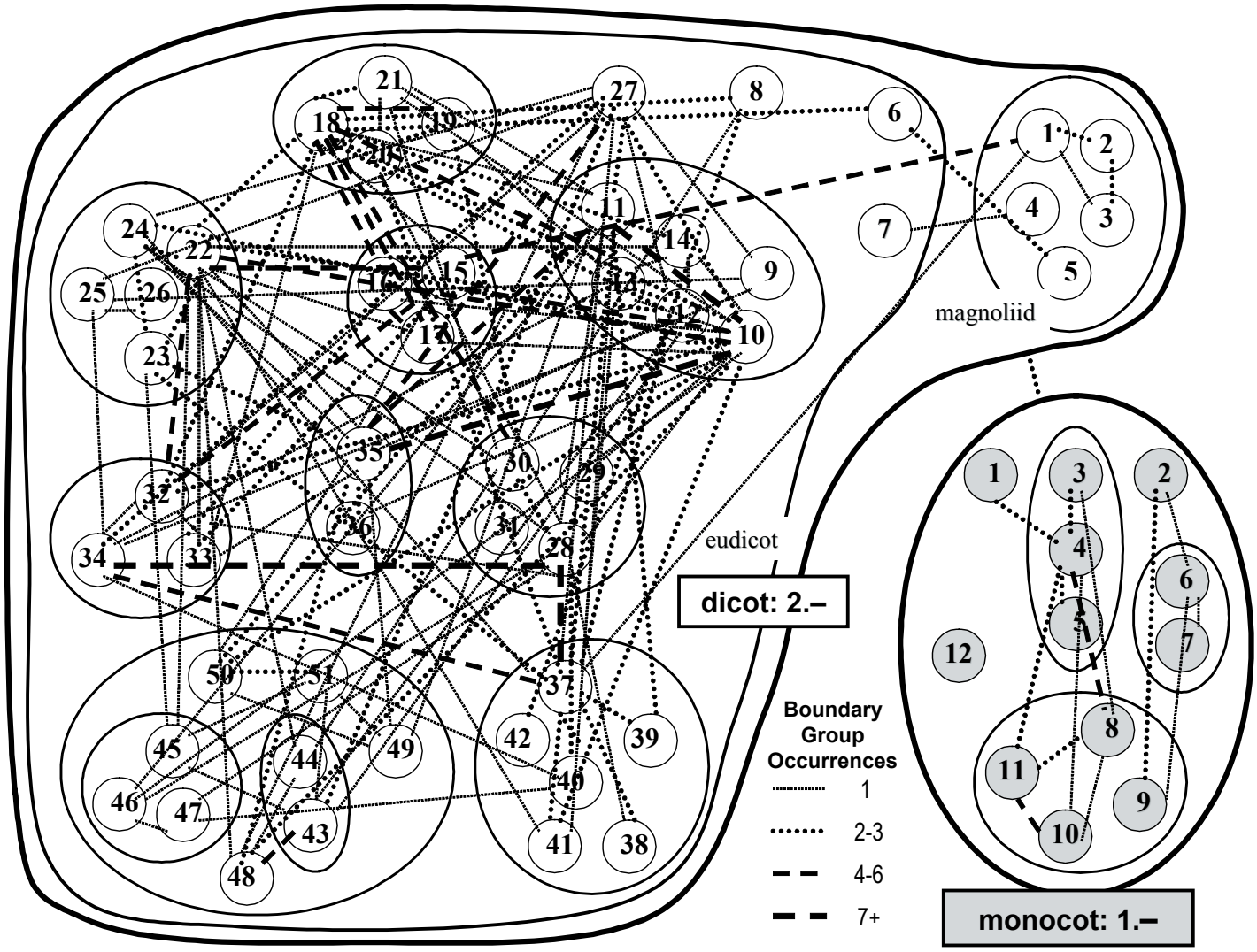

Figure 5. Incorporation of boundary groups in the cognitum systematization of angiosperms. To fully represent the cognitum system, all boundary groups must be indicated. Here varying weights of lines indicate numbers of boundary groups that link any pair of cognita. Note strong reticulate relationships among primary and secondary cognita of the eudicot cognitum and weaker relationships among cognita of the magnoliid and monocot cognita.

6. The cognita represent a likely cognitive response by normally perceptive persons if given adequate detailed visual and tactile observations of the plants in preparation of sorting plants into groups.

Likewise, the cognita are not equivalent to baramins for the same reasons. Because baramins are postulated to have been created separately and to have followed separate histories of diversification, each known species must be assigned uniquely to a single baramin. However, the published baraminological studies (Wood 2006, 2008) suggest that the core groups of the subfamily/family level cognita are likely to approximate the holobaramins. This is because the continuity/discontinuity patterns causing each such cognitum to have been intuitively recognized by all authorities as unified yet distinct are likely to be the same patterns responsible for the biological basis of a holobaraminic boundary. Therefore, the subfamily/family level cognita should be used as starting points for baraminological research.

Relationship of cognitum system to baraminology. On one hand, the cognitum system can be thought of as a short-term substitute to be replaced eventually by a full-fledged baraminic classification. On the other hand, the cognitum system must be viewed as a persisting structure undergirding the study of similarity and design among apobaramins allowing them to be grouped into more inclusive apobaramins without invoking common ancestry. Thus, this cognitum system should provide the starting point to develop theories about interbaraminic design in flowering plants.

For example, Wood (2002) provided evidence that the Poaceae (excluding two genera) constitute a holobaramin. The Poaceae corresponds to the grass cg (1.10.2), suggesting that the Cyperaceae, Juncaceae, Flagellariaceae, Joinvilleaceae, Restionaceae, Centrolepidaceae, Thurniaceae, and additional small families are in an apobaramin with the Poaceae, possibly as multiple holobaramins. Thus, the cognitum system provides a list

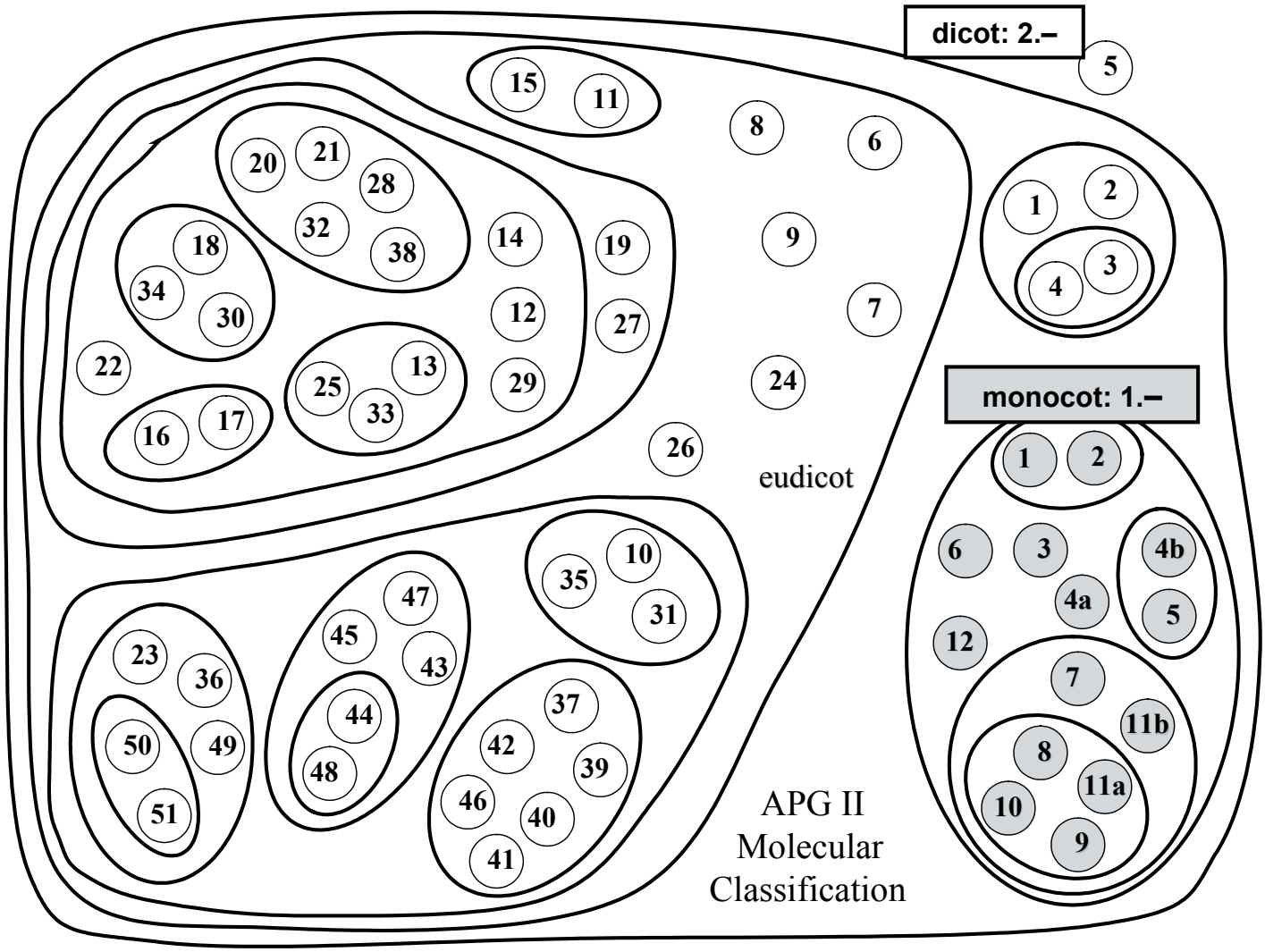

Figure 6. Dispostion of cognita in context of APG Classification II. The core groups of the family/order level primary cognita are organized here into the internested hierarchy dictated by APG II (APG 2003; Soltis et al. 2000, 2005). Note the radical juggling of cognita producing this pattern compared to Figure 3. Note that the magnoliid cg is dismembered and the monocot cg is nested within the dicot cg. Also note the sustained support for all family/order level cognita except the lilian cg (1.4) and the commelinale cg (1.11).

of taxa to sample in baraminology studies of this apobaramin.

The study by Wood (2002) also points out that statistical baraminology can illuminate the cognitum system. The two genera *Anomochloa* and *Streptochaeta*, herbaceous, bamboo-like plants, have historically been accepted as part of the Poaceae. However, baraminic distance correlations using morphological characters suggest strongly that these two genera are discontinuous with the Poaceae, that is, outside the Poaceae holobaramin. This conclusion has actually been supported by the Grass Phylogeny Working Group (GPWG 2001) basing its conclusions largely on molecular phylogenetics. The GPWG places *Anomochloa* and *Streptochaeta* as sister groups to all remaining grasses, i.e., basal and just distal to the lineage leading to the Joinvilleaceae. Therefore, Wood's research clarifies that *Anomochloa* and *Streptochaeta*, as small anomalous genera, are groups in the boundary of the grass cg instead of its core.

Reticulate relationships. Using reticulating cognita to represent similarities among flowering plants highlights the mosaic nature of plant families, which is becoming increasing apparent to conventional biologists usually as rampant homoplasy (e.g., Crepet et al. 1992; Wagner & Altenberg 1996, Soltis et al. 2005, chap. 11). The biological basis of mosaic organisms and character mosaics will no doubt yield great insight into the way God designed structures to function under various constraints, designed genes to be expressed over time, and designed life to retain and reveal design regardless of being subjected to repeated upheavals and catastrophes. In particular, if God designed life to exhibit patterns of similarities as multiple reticulations instead of a single hierarchy, then biologists need a model in which to show this pattern. The cognitum system appears well suited to this need. The systematic distribution of different traits (be they morphological, molecular, behavioral, or ecological) can be laid over the God-designed cognitive-based system to compare and determine the detailed reticulations and mosaic constitution of

organisms. Indeed the cognitum system is evidence that a strict hierarchy in which all taxa are uniquely internested does not exist and is a construct of conventional assumptions of genealogical continuity among all organisms.

Because of the evidence for the holobaraminic status of the Poaceae (Wood 2002), i.e., the grass cg (1.10.2), it is clear that the graminoid cg (1.10) is an apobaramin comprising two or more holobaramins. Therefore, the similarities in floral and spikelet structure of the members of the graminoid cg are likely due to design, as opposed to common ancestry. This allows one to readily determine the taxonomic extent to which structural and functional contraints need to be compared to understand the common design features of the cognitum. Likewise, the secondary farinose cg provides the comparative context to study design of embryological features that are common to members of the graminoid, commelinale, bromeliad, and typhac cognita.

The basis and significance of the greater number of boundary groups per cognitum in the eudicots is not apparent. Perhaps the sharing of recombined traits among a larger number of taxa than in the magnoliids and monocots is a partial explanation.

Relationship to Molecular Data. Due to the persistent failure to determine homology of most morphological traits across angiosperms, recent phylogenetic research on angiosperms has focused almost entirely on molecular data, mostly DNA sequencing. The efforts to convert the molecular cladograms into a unified classification of angiosperms, especially by the Angiosperm Phylogeny Group (APG 2003), have resulted in massive re-arrangements of relationships and taxonomic circumscriptions compared to the traditional classifications of the authorities used as the basis of the present study. In order to compare these recent molecular classifications to the consensus classification obtained here as the basis of delimiting cognita, references to APG Classification II and its circumscription of taxa (APG 2003; Soltis et al. 2000, 2005) are included in Appendix A, using the abbreviation "A" and listing the APG boundary groups in bold. Although the cladograms of various subsidiary groups of the APG II classification have been refined and revised since 2003 by the analysis of additional genes in certain groups, Stevens (2001 onwards) confirms that the APG II has not been significantly modified by these later studies. Therefore, APG II (2003), the underlying three-gene trees (Soltis et al. 2000), and the resulting book by Soltis et al. (2005) are used here as the basis of general comparisons.

What is most striking from the results compiled in Appendix A is the high level of support by the molecular data for the circumscription of the core groups of most of the primary cognita identified. In cases of family/subfamily level primary cognita grouped within order/family level primary cognita, the three possible levels of support are seen. Both the inclusive and included cognita are supported in most cases (graminoid, 1.10; scitamineal, 1.12; magnoliale, 2.1; ranunculan, 2.6; centrosperm, 2.8; rutale, 2.18; myrtale, 2.27; urticale, 2.33; gentianale, 2.43; convolvulale, 2.45; and bilabiate, 2.48, cognita). Only the included but not the inclusive cognita are supported in the cases of lilian (1.4) and violale (2.28) cognita. Only the inclusive is supported in the case of the helobial cognitum (1.1), and neither is supported in the case of the commelinale cognitum (1.11).

This suggests that the core groups of primary cognita are units that are generally internally consistent morphologically, as well as genomically. However, the APG molecular classification groups the order/family level primary cognita in a pattern radically different from that of the consensus of traditional classifications (Figure 6). The decoupling of molecular similarities from morphological similarities just above the family/order level suggests that the circumscribed core groups of cognita at this level or the subfamily/family level may closely reflect the constitution of holobaramins represented by them. In fact, more precise methods of documenting both the decoupling of morphological and molecular characters and mosaic recombination of these characters, so easily depicted in a cognitum system, may eventually prove to serve as a criterion in delimiting holobaramins.

CONCLUSIONS

This paper demonstrates that comparisons of existing classifications by authoritative biologists can serve to identify and systematize cognita quickly. It is thought that the cognitum is biologically significant because God created organisms to be perceived by humans who were created to recognize and sort easily by "gestalt." This cognitum system brings together consistently recognizable groups into a limited number of more inclusive groups that are also easily recognizable while treating anomalous groups with healthy ambivalence. Not only do the cognita suggest boundaries for testing the limits of baramins, but also allows us to look for patterns of both hierarchy and reticulation that are important for understanding the counteracting factors God used in designing the original members of baramins.

Future work is planned to include a detailed accounting of mosaic character distributions of morphological traits in the individual cognita. Also the relationship of molecular data with core and boundary groups of cognita will be examined. In particular the distribution of individual genes on which the published gene trees are based will be used to identify molecular boundary groups and map a molecular reticulum onto the cognitum system. As more holobaramins are identified through hybridization data and stastistical baraminology, the use of the decoupling of genomes from morphology and the mosaic distribution of characters among cognita as holobaraminic criteria can be tested.

ACKNOWLEGMENTS

I thank Kurt Wise and Todd Wood for discussion of these concepts and encouragement to conduct the research. Bryan College supported the later stages of this work. James Gibson and three anonymous reviewers commented on various drafts. The Botanical Research Institute of Texas and colleagues there, though operating under a strictly evolutionary perspective, treated me with respect and allowed me access to library resources. Assistance provided me during this work does not imply endorsement of this paper or any opinions expressed herein, which are solely my own.

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Editor: Marcus Ross

Appendix A. Documentation of Cognita and Included Boundary Groups: Supporting References, Delimitation of Core Groups by Conventional Taxonomic Equivalents, Published Illustrations, and Telegraphic Descriptions.

Assignment of taxa to a particular primary cognitum is based on the circumscription (either explicit or implicit) of conventional taxonomic groups by the intuitive authorities mentioned in the text. In column 2, reference to the circumscription is indicated by a capital letter (C=Cronquist 1981, D=Dahlgren 1975, M=Melchior 1964, R=Thorne 1976, T=Takhtajan 1980; A=Angiosperm Phylogeny Group, see below) followed by a page number (except for Thorne 1976, in which most of the information occurs on pages 56-66). Primary cognita are accepted because a core set of constituent taxa, designated the "core group," are included in each by all five authorities. If the author is not cited as supporting the circumscription, it is because insufficient information was given (unless otherwise noted), and agreement rather than disagreement is assumed. Hierarchical arrangement of cognita reflects agreement of the authorities, as well.

Column 3 lists boundary groups, which are included as constituent taxa only by the authors cited in square brackets following the name. The superscripts preceding the names of boundary groups are index numbers cross-referencing other primary cognita to which they belong as boundary groups and are abbreviated by omitting the 1-for monocots and 2- for dicots. Except for the boundary groups linking the monocots and dicots, the number includes only the digits following the first decimal, for example in the monocots, 4 = core group of cognitum 1.4, 4.2 = 1.4.2. For comparison of cognita with molecular phylogenies, conclusions of the Angiosperm Phylogeny Group (APG 2003; Soltis et al. 2000, 2005) are included in this table. Citation of "A" under "Circumscription" denotes support for the cognitum's core group by the APG; boundary groups that are supported only by the APG are given in bold; morphologically recognized boundary groups that are placed as boundary groups in other cognita only by the APG are noted by underlined cross-reference indices.

Column 4 provides the precise delimitation of the cognitum's core group. Because of the five authorities used in this analysis Melchior (1964) gives the most complete taxonomic hierarchy (down to tribes and representative genera), his classification is used to reference the delimitation. The core group is approximated to the formal taxon or combination of taxa (+ and – used to indicate addition of taxa or subtraction of included taxa, respectively) cited by Melchior. In cases where the core group can unequivocally be associated with the same taxon in Cronquist (1981), the name is followed by an exclamation mark (**!**). If Cronquist uses a different taxon, that name or combination of names is preceded by "**C=".** Reference to illustrations is given for the least inclusive cognita and is indicated by a capital letter (C=Cronquist [1981], H=Heywood *et al.* [2007], M=Melchior [1964], Z=Zomlefer [1994]) followed by a page number and, if necessary, a colon and figure letter or number. Other good sources of diagnostic illustrations include Lawrence (1951), Wood (1974), Tomlinson (1980), Correll & Correll (1982), and Judd *et al.* (2007), as well as searchable images on scholarly or other reliable Internet websites.

The descriptions in column 5 are meant to give a sense of the gestalt of the core group with as brief a review of characters as possible. The descriptions are written to avoid technical terms, other than basic botanical terms available in standard dictionaries. They are not strictly parallel; the general condition prevailing in the next higher grouping is assumed unless stated otherwise. The following are assumed: Plants photosynthetic (green), terrestrial, with taproots; leaves alternate, simple, petioled, and without stipules; flowers "bisexual," more or less in cymose or monopodial branching clusters, radially symmetrical; flower organs more or less whorled, free, i.e., neither connate (fused with like organs) nor adnate (fused to unlike organs); sepals and petals both present and distinct from one another; stamens differentiated into stalk-like filaments and pollen-bearing anthers, if the same number as petals, then positioned between the petals, anthers opening by slits; carpels differentiated into the ovule-bearing ovary, the stalk-like style, and the pollen-receptive stigma; placentation (in simple ovaries) marginal or (in compound ovaries) axile; seeds between the size of sesame seeds and lima beans (small seeds < than sesame seeds, large seeds > lima beans); embryo straight; and endosperm produced during seed development used up by embryo and not present in seed.

To keep descriptions short the following symbols and abbreviations are used: \=or, ×=actinomorphic (radially symmetrical), (|)=zygomorphic (bilaterally symmetrical), $=lacking line of symmetry, &= "and" (parallel series; trait applies to each separately), + = "plus" (together treated as a unit; if number follows, it is the total of all organs together), ± =somewhat variable but centered on a given value, ∞ = numerous (indefinite number usually >10), A=anther(s), alt=alternate, bisex=bisexual (stamens and carpels in same flower), Bl=blade(s), Cp=carpel(s), cmpd=compound, Cot=cotyledon(s), dev=development, Endo=endosperm, epig=epigynous, Fl=flower(s), Fr=fruit(s), H=herb(s), hypog=hypogynous, Infl=inflorescence(s), Lv=(leaf)leaves, no=lacking or without, oft=often, opp=opposite, Ovu=ovule(s), Ovy=ovary(ies), P=petal(s), perig=perigynous, Plac=placenta or placentation, Pto=petiole(s), Rhiz=rhizome(s), rhiz=rhizomatous, S=sepal(s), Schiz=schizocarp(s), Sd=seed(s), Sh=shrub(s), St=stamen(s), Std=staminode(s), Tr=tree(s), undif=undifferentiated, unisex=unisexual (stamens and carpel in separate flowers), usu=usually (one state predominates over one or two other alternates), var=variable (not state predominates), Ven=venation, Vi=vine(s), w=with, Wd=woody plant(s), X= indicates number of stamens by multiplying preceding number times merosity or number of petals.

Cogntium & index code	Circum-scription Ref.	Boundary groups	Equivalent Taxon and Illustrations of Core Group	Description of Core Group
1 monocot	A C1031 D122 M498 R T301	[2-]ceratophyll, [2-]nympaeale, [2-]piperale, [1, 4.2] **petrosavioid [A],** [2, 9] **acorac [A]**	Monocotyledoneae C=Liliopsida	Usu H w sympodial growth & scattered bundles; usu rhiz and/or fibrous rooted; "glazed" surfaces due to construction of epidermal cells; Lv w bases sheathing stem, usu linear, usu w multiple main veins from base converging at tip; floral organs 3 or fewer per whorl; pollen usu w 1 aperature; Endo dev usu free-nuclear; Sd usu w Endo, Cot 1.
1.1 helobial	A C1039 D140 M499 R T301	[4, 6]triuridale [C1039 M512 R T303], [2, 4.1, 4.2] **tofieldioid [A]**, [1-, 4.2] petrosavioid [C1073]	Helobiae C=Alismatidae –Triuridales	Aquatic; Fl oft unisex, organs ±free or some lacking; Endo dev usu helobial (variant of [free]nuclear); no Endo in Sd.
1.1.1 alismatale	C1044 D141 M500 R T301	[1.2]butomac [A C1049 M501 R T301], [1.3] scheuchzeriac [C1056]	Alismataceae ! C1050; M502:A-I; Z298	Lv w usu expanded Bl + Pto; Fl usu bisex, hypog; S 3, P 3.
1.1.2 hydro-charitac	C1052 D141 M503 R T302	[1.1]butomac [D141], [1.3, 2]aponogetonac [D141]	Hydrocharitineae C=Hydrocharitales H373; M504:A-N; Z300	Lv w ±expanded Bl + Pto or linear flat; Fl epig; S 3, P 3.
1.1.3 zosterale	C1055 D141 M506 R T302	[1.2, 2]aponogetonac [A C1056 M506 R T302], [1.1] scheuchzeriac [C1056 D141 M505 R T302], najadac [D141 R]	Potamogetonineae – Aponogetonaceae C=Najadales – (Aponogetonaceae & Scheuchzeriaceae) C1063, 1065; H396, 297; M507, 508, 510	Lv w ±expanded Bl + Pto to thread-like; Fl hypog; S + P 0\4\6 undif scale-like.

Cogntium & index code	Circum-scription Ref.	Boundary groups	Equivalent Taxon and Illustrations of Core Group	Description of Core Group
1.2 aroid	A C1096 D146 M591 R T321	lemnac [C1100 D146 M596 R T321], [1-, 9] acorac [C1096 M593 R T321], [6, 8, 9] sparganiac [R], [1, 4.1, -2] **tofieldioid [A],** [1.2, -3] **aponogetonac [A]**	Araceae – Acoreae ! C1097; M592:D-L; Z302	Oft epiphytic H, oft containing needle-like irritating crystals; Lv usu w ±expanded Bl + Pto; Fl crowded on fleshy spike (spadix) subtended by large bract (spathe); S + P 0\4\6 undif scale-like; Endo dev usu cellular; Sd w oily Endo.
(1.3-1.5) liliiflore				S + P 6, undif, usu petaloid; Cp usu 3, connate; Endo oily w some protein, or failing to develop.
1.3 dioscoreac	C1228 D142 M533 R T312	[4, 4.5, 8] taccad [A C1193 M532 R T313], [4.3, -4, -8, 6] stemonac [R], [4, 4.7, 5] **burmanniac [A],** [4.2, -4] **aletroid [A]**	Dioscoreaceae ! C1229; M533; Z292	Vi from "yam" rootstocks; Lv w ±expanded Bl + Pto, seemingly net-veined; Fl epig; S & P small but ±petaloid; Endo dev usu nuclear; Fr ±3-winged capsule.
1.4 lilian	C1191 D141 M513 T304	[8, 10.1, 11] thurniac [M545], [4.10, -11, 8, 11, 11.3] philydrac [C1193 M539 T311], [1, 6] triuridale [D143 T304], [3, 4.7, 5] burmanniac [D143 M538], [3, 4.5, 8] taccad [D142], [4.6, -9, 11.3] hanguanoid [C1193], [4.4, -6, -9] xanthorrhoeoid [M524], [4.4, -6, -9, 7] dasypogonoid [M524],	Liliineae – (Dioscoreaceae, Taccaceae, Liliaceae: Dasypogoneae) + (Pontederiineae, Iridineae – Geosiridaceae) C=Liliales – (Dioscoreaceae, Philydraceae, Stemmonaceae & Taccaceae)	Lv usu linear\strap-shaped; St 6\3; Endo dev var.
1.4.1 lilioid	A C1210 D143 M520 R	[4.4, 4.6] hyacinthoid[C1210 M521 R T305], [4.5] allioid [C1210 M521 R T306], [4.4, -5, -6, -7, -9] hemerocall [C1210 T306], [4.2] alstroemerioid [C1210 D143 M520 R T306], [4.2] colchicoid [C1210 D143 M519], [4.4] convollarioid [C1210], [4.4, 4.5, -6, -11, 5] hypoxidoid [C1210], [4.2] herrerioid [C1210], [4.4, -5, -7, -11, 5] cyanastrac [C1210], [4.4, -5, -7, -11, 5] tecophilaeac [C1210], [4.4, 5] astelioid [C1210], [1, 2, 4.2] tofieldioid [C1210]	Liliaceae: Lilioideae C1209; H379; M518:C; Z271	Erect H from bulbs; Lv sometimes ±expanded; Fl ±solitary, showy, hypog; Fr capsule w flat, brownish Sd.

Cogntium & index code	Circum-scription Ref.	Boundary groups	Equivalent Taxon and Illustrations of Core Group	Description of Core Group
1.4.2 melanthioid	C1210 D143 M516 R	4.1colchicoid [A T304], uvularioid [A M517 T304], 4.1herrerioid [M517 R T305], 3, 4.4aletroid [M516 T305] , 1, 2, 4.1tofieldioid [M516 T305], 1-, 1petrosavioid [D143 M516 T305], 4.1**alstroemerioid [A],** 4.7, 5 **corsiac [A]**	Liliaceae: Melanthieae M516:A, 518:A; Z277	Erect H, rhiz; Fl ±not showy; S + P w large paired nectaries; Fr capsule w rounded, brownish Sd.
1.4.3 smilacoid	C1225 D142 M523 R T312	4.9philesioid [A C1227 D142 M523 R], 3, 4.4, -8, 6stemonac [T3312]	Liliaceae: Smilacoideae C=Smilacaceae C1226; Z289	Prickly Vi from thick rootstocks; Lv w ±expanded Bl + Pto, seemingly net-veined; Fl unisex, hypog, not showy; Fr berry.
1.4.4 asparagoid	C1211 D142 M522 R T309	4.6, -9dracaenoid [A D142 T309], 4.6nolinoid [A D142 T309], 4.6sansevierioid [T309], 4.1convollarioid [A D142 M522 T309], 3, 4.2aletroid [M523 R], 3, 4.3, -8, 6stemonac [M525], 4.1, -5, -7, -11, 5cyanastrac [D142], 4.1, -5, -7, -11, 5tecophilaeac [D142], 4.1, -5, -6, -11, 5hypoxidoid [D142], 4.7, -9eriosperm [A D142], 4.6, -9phormioid [D142], 4.1, -5, -6, -7, -9hemerocall [D142], 4.1, -6hyacinthoid[A D142], 4.9aphyllanthoid [D142], 4, 4.6, -9xanthorrhoeoid [D142], 4, 4.6, -9, 7dasypogonoid [D142], 4.1, 5astelioid [D142 M522 T309], 4.5, 4.6**doryanth [A]**	Liliaceae: Asparageae Z281	Erect H, rhiz; Lv scale-like, replaced by leaf-like branchlets; Fl hypog, not showy; Fr berry
1.4.5 amaryllidoid	A C1211 D142 M529 R T306	4.1, -4, -7, -11, 5cyanastrac [M527], 4.1, -4, -6, -11, 5 hypoxidoid [M531], 3, 4.8taccad [M532], 4.4, -6doryanth [T307], 4.1allioid [A D142 T306], 4.1, -4, -6, -7, -9hemerocall [T306], 4.6, -6, 8 velloziac [M531]	Amaryllidaceae H342; M529; Z286	Rosette, scapose H from bulbs; Fl in umbels with large bracts, showy, epig; Fr capsule w flat black Sd.
1.4.6 agavoid	C1217 D142 M 525 R T307	4.1, -4, -5, -7, -9hemerocall [T307], 4.4, -9phormioid [T307], 4.4, -5doryanth [C1219 M526 T307], 4.4, -9dracaenoid [C1220 M525], 4.4nolinoid [C1220 M526], 4.4sansevierioid [C1220 M525], 4.9hosta [A T307], 4, 4.9, 11.3hanguanoid [M560], 4, 4.4, 4.9xanthorrhoeoid [C1193], 4, 4.4, 4.9, 7dasypogonoid [C1222], 4.5, -6, 6, 8velloziac [C1193 R], 4.1, -4, -5, -11, 5hypoxidoid [R], 4.1, 4.4**hyacinthoid[A]**	Agavaceae: Agaveae + Yucceae C1218; M526:E-G; Z283	Usu Wd w single or few-branched stem, Lv in rosettes at ends of stems, usu sword-like; Fl ±showy, hypog\epig; Fr capsule w flat black Sd.

Cogntium & index code	Circum-scription Ref.	Boundary groups	Equivalent Taxon and Illustrations of Core Group	Description of Core Group
1.4.7 irid	C1211 D143 M535 R T309	[5]geosiridac [A D143 M538 R], [4.1, -4, -5, -11, 5]cyanastrac [A T309], [4.1, -4, -5, -11, 5] tecophilaeac [A T309], [3, 4, 5]burmanniac [T313 R], [4.2, 5]corsiac [M539], [4.4, 4.9]eriosperm [T310], [4.1, -4, -5, -6, -9]**hemerocall [A]**	Iridaceae ! C1212; H375; M536; Z279	Lv mostly basal from Rhiz or bulb, linear, equitant; Fl showy, epig; St 3; Fr capsule w rounded, colored Sd.
1.4.8 trillioid	C1211 D142 M522 T312	[3, 4.3, -4, 6]stemonac [D142 T312]	Liliaceae: Parideae M518I; Z373	Erect stem from Rhiz w Lv in a single whorl; Lv expanded, net-veined; Fl ±showy, hypog, S often differentiated; Fr capsule or berry.
1.4.9 aloeoid	A C1215 D142 M517 R T307	asphodeloid [A M517 T307], [4.1, -4, -5, -6, -7]hemerocall [A M518], [4.6]hosta [M518], [4.3]philesioid [M523], [4.4]aphyllanthoid [M518 T308], [4.4, -7]eriosperm [M519 T308], [4.4, -6]dracaenoid [R], [4, 4.4, -6]xanthorrhoeoid [A M524 R T308], [4, 4.6, 11.3]hanguanoid [R T308], [4, 4.4, -6, 7] dasypogonoid [T308], [4.4, -6]**phormioid [A]**	Liliaceae: Aloeae C=Aloeaceae C1216; H351; M518F	Lv in rosettes from Rhiz or aerial woody stems, sword-like, ±succulent; Fl ±showy, hypog, S & P adnate into tube; Fr usu capsule w flat, brown Sd.
1.4.10 pontederiac	C1202 D142 M534 R T311	[4, 4.11, 8, 11, 11.3] philydrac [R]	Pontederiaceae ! C1203; H395; M535; Z311-313	Aquatic H; Lv w Pto, expanded; Fl in spikes, showy (oft blue), hypog, (|); Fr capsule or warty nutlet w round, brownish Sd.
1.4.11 haemodorac	C1204 D142 M527 R T310	[4.1, -4, -5, -7, 5]cyanastrac [M527 R], [4.1, -4, -5, -7, 5] tecophilaeac [M527 R], [4.1, -4, -5, -6, 5] hypoxidoid [T310], [4, 4.10, 8, 11, 11.3] philydrac [D142]	Haemodoraceae – (Conostylideae p.p. & Conanthereae) C1205; H369; Z316	H of wet acid soils, w blood-like sap; Lv mostly basal from Rhiz, equitant; Fl not showy, wooly, epig; Fr capsule w flat brownish Sd.
1.5 orchid	A C1238 D143 M614 R T313	[3, 4, 4.7]burmanniac [C1232], [4.2, -7]corsiac [C1232 M539], [4.7]geosiridac [C1232], [4.1, -4, -5, -6, -11]**hypoxidoid [A],** [4.1, -4, -5, -7, -11]**cyanastrac [A],** [4.1, -4, -5, -7, -11] **tecophilaeac [A],** [4.1, -4]**astelioid [A]**	Orchidaceae ! C1239; H384-387; M615, 618, 621; Z294, 295	Terrestrial\epiphytes w mycorrhizal roots; Lv linear to ±expanded & succulent; Fl showy, epig, (|); S & P petaloid, middle P elaborate (lip); St usu 1 adnate to style; Fr capsule with minute Sd; Endo dev abortive.

Cogntium & index code	Circum-scription Ref.	Boundary groups	Equivalent Taxon and Illustrations of Core Group	Description of Core Group
(1.6-1.7) palmiform				Large Wd w unique embryology & stomates; Lv clustered toward ends of stems; Fl not showy, small & numerous. Fr drupe, oft dry\fibrous.
1.6 pandan	C1090 D146 M598 R T320	[7]cyclanth [A D146 M598 R T320], [2, 8, 9]sparganiac [M598], [1, 4]**triuridale [A],** [4.5, -6, 8] **velloziac [A],** [3, 4.3, -4, -8] **stemonac [A]**	Pandanaceae ! H388; M599	Branched w linear spiny Lv in 3-4 spiral rows; Fl fused into congested unisex spikes, S & P ±lacking; Drupes form woody cone-like mass; Endo dev nuclear, Sd w oily Endo.
1.7 palm	A C1082 D146 M579 R T319	[6]cyclanth [C1089 D146 M589 R T320], [4, 4.4, -6, -9] **dasypogonac [A]**	Palmae C=Arecaceae C1083; H348, 349; M580, 583; Z306	Unbranched w large expanded, pleated Bl + Pto; Infl usu much branched, at base of Lv; Fl var, S & P undif, scale-like; Endo dev nuclear; Sd w oily Endo.
(1.8-1.11) farinose				Small-medium H; Fl ±lacking nectaries, hypog, 2-\3-merous; if present, S & P form 2 differentiated whorls; Sd w starchy Endo.
1.8 bromeliad	A C1161 D143 M546 R T315	[9, 11.2]rapateac [A], [4, 10.1, 11]thurniac [M545], [4, 4.10, -11, 11, 11.3]philydrac [T314], [3, 4, 4.5]taccad [D143], [4.5, -6] velloziac [D143], [2, 6, 9]**sparganiac [A]**	Bromeliaceae ! C1162; H353-355; M547; Z309	±Epiphytes, usu scapose w basal rosette of tough Lv, oft forming water-holding tank, covered with silvery scales; Infl branched w showy bracts; Fl showy in mass; Fr usu capsule; Endo dev helobial; Sd small, plumed.
1.9 typhac	C1155 D144 M601R T320	[2, 6, 8]sparganiac [A C1150 D144 M601 R T320], [1-, 2]acorac [C1099], [8, 11.2] **rapateac [A]**	Typhaceae ! M601; Z318	Aquatic; Lv in 2-rowed basal cluster from Rhiz; Fl minute & crowded into thick velvety unisex spikes; S & P represented by bristles; Fr minute plumed nutlet; Endo dev helobial.

Cogntium & index code	Circum-scription Ref.	Boundary groups	Equivalent Taxon and Illustrations of Core Group	Description of Core Group
1.10graminoid	A C1127 D145	10.2, 11ecdeiocoleac [R], 10.2flagellariac [C1133 R], 10.2joinvilleac [C1133 R], 10.2, 11restionac [C1133 R], 10.2, 11centrolepidac [C1133 D145 R], 11 **hydatell [A],** 11 **eriocaul [A]**	Graminales + (Juncaceae & Cyperales)	Lv mostly basal from Rhiz; Fl not showy, often tightly covered with chaffy scales in tight clusters or miniature spikes; S & P scale- or bristle-like or lacking; Endo dev var.
1.10.1 juncad	A C1129 D145 M543 R T315	4, 8, 11thurniac [A C1126 D145]	Juncaceae ! H377; M544:A-0; Z346	Stems w pith; Lv in 3 rows, sheath open (margins overlapping down one side of stem); Fl in heads or irregularly branched clusters, ±bisex; St 3\6; Fr capsule w small Sd.
1.10.2 grass	A C1142 D145 M561 R T318	10, 11flagellariac [A D145], 10joinvilleac [A D145], 10, 11restionac [A D145], 10, 11 **centrolepidac [A],** 10 **ecdeiocoleac [A]**	Poaceae ! C1143; H391-394; M563, 566; Z346	Stems usu no pith; Lv in 2 rows, sheath open; Fl in "shingled" spikelets (which can be in branched clusters or cmpd spikes, mostly bisex; St 3; Fr 1-seeded grain.
1.10.3 cyperac	A C1139 D145 M603 R T315		Cyperaceae ! C1140; H364; M604-605; Z348	Stems w pith; Lv in 3 rows, sheath closed (tubular); Fl in "shingled" spikelets (which can be in branched clusters or heads), bi-\unisex; St 3; Fr 1-seeded nutlet.
1.11 commelinale	C1105 D144 M549 T316	10eriocaul [C1118 D144 M555 R T317], 10, 10.2centrolepidac [M558 T317], 10, 10.2flagellariac [M559 R T317], 10, 10.2restionac [C1127 M557 T317], 10hydatell [C1149 M559 T317], 4, 8, 10.1thurniac [D144 R], 4, 4.10, -11, 8, 11.3philydrac [R]	Commelinaceae + (Mayacaceae & Xyridaceae)	Lv from Rhiz, linear or somewhat expanded w Pto; Fl ±showy, usu bisex, hypog; S 3; P 3, deliquescent; Fr capsule; Endo dev nuclear.

Cogntium & index code	Circum-scription Ref.	Boundary groups	Equivalent Taxon and Illustrations of Core Group	Description of Core Group
1.11.1 mayacac	C1111 D144 M552 R T317		Mayacaceae ! C1112; M551:N-S	Aquatic H; Lv small, densely spiraled around stem; Fl solitary; P whitish.
1.11.2 xyrid	C1109 D144 M552 R T316	[8, 9]rapateac [C1109 D144 M553 R]	Xyridaceae ! C1110; M554:A-E; Z340	Scapose H of acid wet soils w basal Lv rosette; Infl a cone-like head of varnished scales w 1 showy Fl appearing at a time; P yellow.
1.11.3 commelinac	C1113 D144 M550 R T316	[4, 4.10, -11, 8, 11] **philydrac [A],** [4, 4.6, -9] **hanguanoid [A]**	Commelinaceae ! C1114; H359, 360; M551: A-M; Z342	Semi-succulent, mucilaginous H; Lv w short, tubular sheath, oft somewhat expanded w Bl + Pto; Fl in sheathed or open cluster, usu 1 Fl appearing at a time; P bluish\purplish.
1.12scitamineal	A C1165 D144 M607 R T319		Scitamineae C=Zingiberales	±Large H; Lv mostly basal from Rhiz, ±large, expanded Bl + Pto; Fl showy, epig; S 3, P3; if present, Std petaloid & usu larger than P; Endo dev var; Sd w starchy Endo.
1.12.1 musac	A C1173 D144 M609 R T319	strelitziac [A C1166 R M608], heliconiac [A C1166 R M608], [12.3]lowiac [A C1166 R], [12.2] **cannac [A]**	Musaceae: Musoideae C=Musaceae C1174; H382, 383; M608: A-E; Z324	Tree-like; Lv in spiral; Fl (|) w 3S + 2P fused, 1P free; St 5; Fr berry. .
1.12.2 ginger	A C1177 D144 M609 R T319	[12.3]costac [C1166 R M611], [12.1] **cannac [A]**	Zingiberaceae – Costoideae C=Zingiberaceae C1178; H408; M610; Z320, 321	Plants w spicy odor; Lv in 2 rows; Fl (|) w 3 connate S & 3 connate P; St 1; Std ±4, 2 fused into showy lip; Fr capsule; Sd w arils (fleshy or fibrous coating).

Cogntium & index code	Circum-scription Ref.	Boundary groups	Equivalent Taxon and Illustrations of Core Group	Description of Core Group
1.12.3 marantac	A C1185 D144 M611 R T319	12.1, -2cannac [C1169 M611 R T319], 12.1lowiac [M612], 12.2 **costac [A]**	Marantaceae ! C1186; H381; M612:A; Z336, 337	Lv ± in 2 rows, w sleep movements, oft striped\ spotted purplish; Fl $, in mirror-image pairs, w only one half St; Std ±4, 1 forming spring-loaded hood over stigma; Fr capsule\ berry.
2 dicot	C17 D122 M37 R T258	1-ceratophyll [D125+f.2], 1-nympaeale [C2+1034 D125+f.2 T237], 1-piperale [D124+f.2 M148]	Dicotyledoneae C=Magnoliopsida	Wd\H w ±monopodial growth & vascular bundles in ring; usu tap-rooted; surfaces not "glazed," Lv usu w Pto + expanded Bl, bases usu not sheathing stem, w 1 main vein (pinnate Ven) or few main veins (palmate Ven) from base & branching to form net Ven; Endo dev var; Cot 2.
(2.1-2.5) magnoliid				Oft aromatic\spicy; Lv ±oval, ±entire; Fl organs in indeterminate spirals or multiple whorls of 3 or fewer members; ±free; pollen w 1 aperature.
2.1 magnoliale	A C31 D122 R T258	2**amborell [A],** 2**trimeniac [A],** 9, 11, 24, 28.1 **berberidopsidoid [A]**, 2austrobaileyac [A C48], 1.2, -3eupomatiac [C47 D122 M116 T259], 2, 3, 4 lactoridac [C53], illiciac [A C94 D124 M119 R T259], schisandrac [A C98 D124 M118 R T259], 9, 15tetracentrac [M127], 9, 15trochodendrac [M128], 6.3, -4, 15eupteleac [M129], 11, 15cercidophyll [M129], 5**ceratophyll [A],** 2, 3**chloranthac [A]**, 8, 24, 37dilleniac [C288]	Magnoliaceae + (Degeneraceae, Himantandraceae, Winteraceae, Annonaceae, Myristicaceae & Canellaceae) !	Tr; Ven pinnate, Magnolioid (finer veins ±arranged randomly, not organized into size classes); Fl ±solitary, ±showy, hypog; St & Cp parts not well differentiated, somewhat leaf-like; Sd w Endo.
2.1.1 winterac	A C38 D122 M112 R T258	1.2, -3himantandrac [C44 D122 M112 R], 1.2, -3degeneriac [C41 D122 M112], 1.3, -4**canellac [A]**	Winteraceae ! C39; H337; M113	Lv w no stipules; Infl few-flowered umbels; S & P spiraled; Cp & Fr in single whorl; Fr fleshy follicles

Cogntium & index code	Circum-scription Ref.	Boundary groups	Equivalent Taxon and Illustrations of Core Group	Description of Core Group
2.1.2 magnoliac	A C49 D122 M110 R T259	1.1, -3degeneriac [A R T258], 1.1, -3himantandrac [A D122 R T259], 1-, 1.3eupomatiac [R]	Magnoliaceae ! C50; H198,199; M110; Z30	Lv w stipules (which wrap around stem); S & P in spiral or 3, 3-merous whorls; Cp & Fr in cone-like spiral; Fr winged nutlets or follicles w fleshy-coated Sd.
2.1.3 annonac	A C53 D122 M113 R T259	1.1, -4canellac [C57 D122 T259], 1.1, -2 **himantandrac [A]**, 1, 1.2eupomatiac [A C55], 1.1, -2 **degeneriac [A]**	Annonaceae ! C54; H33, 34; M114; Z32	Lv w no stipules, in 2 rows along the horizontal twigs; S 3 & P6, fleshy; Cp in single whorl, oft fused in fruit as large fleshy berry.
2.1.4 myristicad	A C55 D122 M116 R T259	1.1, -3canellac [C58 D122 M117 R T259],	Myristicaceae ! H223; M117	Lv w no stipules, often in 2 rows along the horizontal twigs; Fl unisex; S 3, fused into urn shape; P 0; Cp 1; Fr capsule w 1 large Sd covered w fleshy coating.
2.2 laurale	A C59 D124 R M109 T259	1 amborell [C64 M120 R T259], 1 austrobaileyac [C48 M119 R T259], 1 trimeniac [C66 M120 R T259], 1, 3, 4lactoridac [C53 D124 R T260], 1, 3chloranthac [D124 R T259]	Lauraceae + (Calycanthaceae, Gomortegaceae & Hernandiaceae) C=Laurales – (Amborellaceae & Trimeniaceae C67, 71, 73, 75; H81, 183, 216, 217; M121, 123, 124; Z36	Tr; Lv oft w 3 main veins from base, Ven Magnolioid; Fl ±in panicles, ± not showy, perig\epig; St & Cp parts usu well differentiated; Fr drupe.
2.3 piperale	A C80 D124 M148 R T260	1, 2, 4lactoridac [C80 M148], 1, 2chloranthac [C80 M148], 4, 7**hydnorac [A]**	Piperaceae + Saururaceae ! C86, 87; H255, 298; M148, 149; Z38	H or soft Wd w scattered vascular bundles; Lv w palmate, Magnolioid Ven; Fl minute, crowded on fleshy spike, bi-\unisex, hypog; S & P ±lacking; St & Cp few; Fr drupe.

Cogntium & index code	Circum-scription Ref.	Boundary groups	Equivalent Taxon and Illustrations of Core Group	Description of Core Group
2.4 aristolochiac	C90 D124 M152 R T260	[3, 7]hydnorac [A M155], [1, 2, 3] **lactoridac [A]**	Aristolochiaceae C=Aristolochiales C91; H45; M152; Z34	H or soft Wd Vi; Lv w palmate, Magnolioid Ven; Fl showy, ±solitary, epig, w carrion odor; S 3, fused into tube; P ±0; Fr capsule.
2.5 nymphaeale	A C100 D125 M143 R T261	[6, 9]nelumbonac [C100 M145 R T261], [1]ceratophyll [C100 D125 M146 R T261], [6]nuphar [A C100 M145 R T261]	Nymphaeaceae – (Nuphareae & Nelumbonoideae) C110, 114; H231; M144: A-E; Z50:2, 53	Aquatic H w ±scattered vascular bundles; Lv w palmate, Magnolioid Ven; Fl showy, ±solitary, hypog; S 3-6; P 3-∞; St ∞; Cp in single whorl.
(2.6-2.51) eudicot				Only sometimes aromatic\ spicy; Lv var; Fl organs usu 4\5 per whorl, free\fused; pollen usu w 3 aperatures.
2.6 ranunculan	A C116 D124 R T261	[9, 18, 18.4]sabiac [A C140], [18, 18.1, -2, 29]coriariac [C139], [5, 9]nelumbonac [D125], [5]nuphar [D125]	Ranunculineae + Papaverineae	H\soft Wd, non-aromatic; Lv ±ternately veined or divided, entire or with Chloranthoid teeth (large w 3 veins converging); Fl similar to magnoliid cg, hypog.
2.6.1 ranunculac	A C124 D125 M133 R T261	[6.3]circaeaster [C127 D125 M137 R T261], [6.2]podophyll [C126]	Ranunculaceae – Kingdoniinae C=Ranunculaceae C125; H273-275; M134; Z43, 44	H; Fl ± showy; S ±5; P ±5; Fr. follicles\nutlets.
2.6.2 berberidac	A C128 D125 M137 R T261	[6.1]podophyll [C130 D125 M137 T261]	Berberidaceae – Podophylloideae ! C128; H60; M138:C-I	Usu Sh; Fl ±not showy\ showy in mass; S 6; P 9\12\15; St ±6\12; Cp ±1; Fr berry.

Cogntium & index code	Circum-scription Ref.	Boundary groups	Equivalent Taxon and Illustrations of Core Group	Description of Core Group
2.6.3 menisperm	A C133 D125 M140 R T261	lardizabalac [A D125 M139 T261], sargentodoxac [A D125 M139 T261], [6.1] **circaeaster [A],** [1, 6.4, 15] **eupteleac [A]**	Menispermaceae ! C134; H121; M141; Z41	Vi; Fl not showy, similar to berberidac cg, unisex; Cp ±3; Fr berry-like.
2.6.4 papaverac	A C141 D125 M179 R T261	[1, 6.3, 15] **eupteleac [A]**	Papaveraceae C=Papaverales C146, 148; H241, 242; M179, 181; Z46, 47	H\soft Wd w red or yellow latex; Fl ±showy; S ±2; P ±4, Cp several, connate w 1 chambered Ovy; Fr capsule.
2.7 rafflesiac	C703 D124 M153 R T260	[3, 4]hydnorac [C696 D124 M155 R T260], mitrastemonac [C702 M154 R]	Rafflesiaceae – Mitrastemoneae C=Rafflesiaceae H121, 272; M154	Internal parasite on other plants, reduced to fungus-like threads except for flowering shoots that emerge; Fl ±unisex; showy\ not; fleshy & tubular formed from brownish petaloid S.
2.8 centrosperm	A C236 D140 R T268	[42]polygonac [A C280 M75 R T269], [42]plumbage [A C285 T270], [18.4, 30]gyrostemonac [M84], [8.1, -2]agdestidac [D140], [18.1]rhabdodendrac [A R], [28.5]**frankeniac [A],** [28.5]**tamaricad [A],** [37] **asteropeiac [A],** [10, 15, 32] **simmondsiac [A],** [11, 37, 39] **droserac [A],** [11, 37, 39]**nepenthac [A],** [28, 27] **dioncophyll [A],** [20, 28, 37] **ancistroclad [A],** [1, 24, 37] **dilleniac [A],** [18]**physenac [A]**	Centrospermae + Cactales C=Caryophyllales M79-80	Oft succulent H\soft Wd, anthocyanin pigments usu replaced by betalains; Ven pinnate, Magnolioid or more simplified; Fl var but Ovy\Fr usu w single chamber; Plac ±basal\free-central; Embryo ±coiled.
2.8.1 phytolaccad	A C248 D140 M82 R T268	[8.6]achatocarp [M84 R T269], [8, 8.2]agdestidac [A C249 M84 R T268], [8.8]stegnosperm[M84 R T269], [8.4, -5, -6, -7, -8]molluge[M86], [8.6]lophiocarp [C264 M84], [8.4, -6]microteoid [C264 M84 R T268], [8.2, -4, -5]gisekioid [C249 M87 T268], [8.2, -6] **sarcobatac [A],** [8.2, -4]petiverioid [C249 M84 T268]	Phytolaccaceae: Phytolacceae C248; H253; M83:A-E; Z62	Fl not showy, in racemes, greenish-white, hypog; S 4\5; P 0; Fr berry\multiple berry.
2.8.2 nyctage	A C251 D140 M84 R T268	[8, 8.1]**agdestidac** [A], [8.1, -6]**sarcobatac [A],** [8.1, -4, -5]**gisekioid [A],** [8.1, -4] **petiverioid [A]**	Nyctaginaceae ! C252; H230; M86:A-G; Z64	Lv opp but 1 in each pair smaller; Fl ±showy, in few-flowered cymes, tubular, of connate S; Fr achene.

Cogntium & index code	Circum-scription Ref.	Boundary groups	Equivalent Taxon and Illustrations of Core Group	Description of Core Group
2.8.3 cactus	A C257 D140 M102 R T269		Cactaceae ! C258; H78; M104; Z59	Stem succulent w clustered spines; Lv oft bract-like and quickly falling; Fl showy, usu solitary, epig; P ∞; St ∞; Plac usu parietal (basal in generalized members); Fr berry.
2.8.4 aizoac	A C254 D140 M87 R T268	8.1, -5, -6, -7, -8molluge[A M86], 8.1, -6**microteoid [A],** 8.1, -2, -5 **gisekioid [A],** 8.1, -2**petiverioid [A]**	Aizoaceae ! C254; H214; M86:H-M, O-Q	Lv succulent; Fl showy, usu solitary, epig; P ∞, linear; St 4 - ∞; Ovy\Fr ±several chambered; Fr capsule.
2.8.5 caryophyll	A C272 D140 M83 R T269	8.1, -4, -6, -7, -8molluge[A C272 R T269], 8.1, -2, -4gisekioid [C249 M87]	Caryophyllaceae ! C273; H90; M94; Z55	No betalains; nodes swollen; Lv opp, often narrow; Fl ±showy, in few-flowered cymes, hypog; S &P 5, St 5; Fr capsule.
2.8.6 chenopod	A C263 D140 R M69 T269	8.7halophytac [D140], 8.1lophiocarp [C264], 8.1, -4microteoid [C264], 8.1, -2sarcobatac [C264 M99], 8.1, -4, -5 -7-8**molluge[A],** 8.1**achatocarp [A]**	Chenopodiineae – (Chenopodiaceae: Sarcobateae & *Halophytum*) C=Chenopodiaceae + Amaranthaceae C262, 265; H28, 96, 97; M98; Z66, 68	Fl not showy, in densely crowded clusters; S ±scale-like, ±5; P 0; Fr 1-seeded capsule\nutlet.
2.8.7 portulacad	A C267 D140 M90 R T269	8.8basellac [A C270 D140 M92 R T269], 8.1, -4, -5 -6, -8 **molluge[A],** 8.6**halophytac [A]**	Portulacaceae ! C267; H265; M91:A-K	Lv succulent w scarious or tufted stipules; Fl ±showy; S2; P ±5; Fr capsule w several Sd.
2.8.8 didiereac	A C256 D140 M102 R T269	8.1**stegnosperm** [A], 8.1, -4, -5, -6 , -7**molluge[A],** 8.7**basellac [A]**	Didiereaceae ! H126	Cactus-like stem succulent; Lv ±small & oval surrounded by 1-4 conical spines; Fl ±not showy; unisex; S 2; P 4; Fr achene.

Cogntium & index code	Circum-scription Ref.	Boundary groups	Equivalent Taxon and Illustrations of Core Group	Description of Core Group
(2.9-2.14) rosan				Mostly Wd; Lv oft dissected and/or w Rosoid teeth (basal branch vein goes to sinus above, no deciduous appendage) and Rosoid Ven (stitching between pinnate veins, brace in vein axils, fine veins rigidly arranged & organized into size levels); suite of anatomical & embryological similarities.
2.9 proteac	A C608 D133 M60 R T292	[25, 27, 33, 34]elaeagnac [C602 D134], [5, 6]**nelumbonac [A],** [1, 15]**trochodendrac [A],** [1, 15]**tetracentrac [A],** [15]**platanac [A],** [6, 18, 18.4]**sabiac [A],** [10, 15, 22, 32]**buxac [A],** [15, 17, 22, 32]**didymelac [A],** [11, 24, 27, 35]**gunnerac [A],** [10, 15, 24]**myrothamnac [A],** [1, 11, 24, 28.1]**berberidopsidoid [A],** [11, 18.4, 22, 24, 32]**aextoxicad [A]**	Proteaceae ! C609; H268; M61	Evergreen Sh\Tr; Lv ±leathery; Fl in racemes or dense showy heads, hypog; S 4, ±petaloid, ±fused into tube or split tube; P 0; St 4. Fr. nut\achene.
2.10 hydrangeoid	A C561 D138 M204 R T279	[27, 29]anisophyll [C565], [20, 27, 28, 32, 35]rhizophorac [C659], [9, 15, 22, 32]buxac [R], [8, 15, 32]simmondsiac [R], [12, 13, 14, 18]connarac [C542 D133 T282], [35, 43, 48.4]columelliac [C538 D138 R T280], [36]pittosporac [C538 M208 R T280], [11, 12, 21]tremandrac [D135 R], [12, 23, 36, 49]bruniac [C538 M209 R T280], [23]phyllonomac [C561 M206 R T279], [35, 48, 48.7]hydrostachydac [A R], [41, 48.2]byblidac [C537 M208 R T280], [37, 41]roridulac [C554 M208 R T280], [22, 24]balanophorac [D123 R], [24, 27]cynomoriac [D135], [11]ribesioid [C561], [23, 35, 36, 49, 50, 51]escallonioid [C561 D138 M205 R T791], [11, 12, 35]iteoid [C561 M205 R T791], [11, 22, 50]brexioid [C561 M204 R T279], [23, 36]tribelac [C561 D138 M205 T279], [22, 45]montiniac [C561 M206 R T279], [35, 51]alseuosmiac [C538 D138 R T280], [11, 35]pterostemonac [C561 D138 M204 R T280], [11, 35]tetracarpaeac [C561D138 M205 R T279], [11, 18.4, 19]greyiac [C538 D134], [11, 28, 28.5, 37, 40, 46]fouquieriac [D134], [11, 15, 32]daphniphyll [R], [19, 22]geissolomatac [R], [24, 35, 41]grubbiac [R], [9, 15, 24]myrothamnac [R], [15, 22]styloceratac [R], [15, 16, 17, 20, 21, 32, 38]balanopac [R], [11, 35, 50]stylidiac [D138], [11, 35, 50, 51]donatiac [D138], [11, 35, 36, 49]eremosynoid [D138]	Saxifragaceae: Hydrangeoideae C=Hyrangeaceae C556; M202:E, L-N; Z186	Small ±Wd; Lv usu opp; Fl ±showy or showy in mass, ±half epig w definite hypanthium, 4-\5-merous; St 2 or more X; Styles ±separate; Fr capsule.

Cogntium & index code	Circum-scription Ref.	Boundary groups	Equivalent Taxon and Illustrations of Core Group	Description of Core Group
2.11 saxifragoid	A C570 D135 M202 R T280	[12]cephalotac [C570 D134 M200 R T281], [8, 37, 39]droserac [R T282], [8, 37, 39]nepenthac [T285], [10, 18.4, 19]greyiac [R T281], [22, 37]parnassioid [C570 M204 R T281], [13]astilboid [A C570 M202 T281], [10]ribesioid [A D135 M203 R T281], penthoroid [A C569 D135 M201 R T281], [27, 35]haloragac [A C616 D134], [9, 24, 27, 35]gunnerac [A C616 D135 T282], [23, 43, 45, 47]vahlioid [C572 D135 M203 R T281], [10, 36, 49]eremosynoid [C572 M203 R T281], [19]francooid [C572 D134 M203 R T281], [10, 22, 50]brexioid [D134], [22, 37]lepuropetaloid [C572 M204 R T281], [10, 35, 50]stylidiac [R], [10, 35, 50, 51]donatiac [R], [38]podostemac [C612 D134 R T287], [37, 41, 46]diapensiac [R], [35, 49]adoxac [C1011], crassulac [A C538 D137 M199 R T281], [10, 12, 21]tremandrac [D137], [10, 28, 28.5, 37, 40, 46]fouquieriac [D135], [1, 15]**cercidophyll [A],** [10, 12, 35]**iteoid [A],** [10, 35]**pterostemonac [A],** [37]**paeoniac [A],** [10, 35]**tetracarpaeac [A],** [12]**aphanopetalum [A],** [10, 15, 32]**daphniphyll [A],** [15]**altingiac [A],** [1, 9, 24, 28.1]**berberidopsidoid [A],** [9, 18.4, 22, 24, 32]**aextoxicad [A]**	Saxifragaceae: Saxifrageae C571; H299; M202:B, F-H	Rosette, ±scapose H; Fl similar to hydrangeoid cg; St 1\2 X; Fr capsule.
2.12 cunoniac	C545 D133 M206 R T278	bauerac [A C547 D133], [13]brunelliac [A C541 D133 M206 R T278], [10, 23, 36, 49]bruniac [D133], [37]eucryphiac [A C545 D133 R T279], davidsoniac [A C550 M207 R T279], [10, 11, 35]iteoid [D133], [10, 13, 14, 18]connarac [A C543], [27, 43, 43.4]dialypetalanth [C550], [22, 29]corynocarp [R], [20, 28, 37]medusagynac [R], [18, 19, 22]staphyleac [C791 R], [11]aphanopetalum [C545], [10, 11, 21]**tremandrac [A],** [14, 21, 22]**krameriac [A],** [14, 22, 28, 34, 40]**huac [A],** [19]**oxalidac [A],** [34]**elaeocarp [A],** [11]**cephalotac [A]**	Cunoniaceae C546; H118; M207	Sh\Tr; Lv usu opp, oft w interpetiolar stipules (fused between petioles), oft pinnately divided; Fl not showy, in small panicles, hypog, 4-\5-merous; P smaller than S; St 2 X; Fr capsule.
2.13 rosac	A C573 D133 M209 R T282	[20, 21, 32, 38]chrysobalanac [C582 M219 R T282] [18.4]stylobasiac [C584 M220], [14, 18.1]surianac [C584], [11]astilboid [C573], [34]neurad [C578 M218 R T282], [19, 37]crossosomatac [D133 R], [18.4, 19]melianth [D133], [12] brunelliac [C541], [18, 19]biebersteiniac [D127], [10, 12, 14, 18]connarac [R]	Rosaceae ! C574; H281-283; M211, 212, 216; Z182, 183	Tr\Sh\H; Lv w stipules; Fl usu showy, usu in panicles\umbels, perig\epig w hypanthium, 5-merous; P clawed; St ∞; Cp free; Fr follicles\multiple drupes\ w fleshy accessory parts.

Cogntium & index code	Circum-scription Ref.	Boundary groups	Equivalent Taxon and Illustrations of Core Group	Description of Core Group
2.14legume	A C587 D133 M221 R T282	[10, 12, 13, 18]connerac [C5442 M220 T282], [21]**polygalac [A]**, [12, 21, 22]krameriac [A M241], [18, 19, 20, 22]**zygophyll [A],** [18, 18.1, 19, 20]**balanitac [A],** [12, 22, 28, 34, 40]**huac [A],** [13, 18.1]**surianac [A]**	Leguminosae C=Fabales C593, 396, 599; H185-188; M223, 226, 229, 231; Z161-163	Tr\Sh\H; Lv w stipules & pulvini (petiole swellings), usu cmpd, entire, Ven not rigidly arranged but otherwise Rosoid; Infl var; Fl usu showy, perig w hypanthium, 5-merous; P clawed; St 1-3 X; Cp 1 w long style; Fr legume.
(2.15-2.17) fagan				Tr\Sh; Lf teeth var; Fl not showy, in heads\reduced heads (burs, acorns)\ drooping spikes, wind pollinated, oft unisex; P ±0; Fr nut, ±clustered.
2.15hamamelid	A C163 D132 M196 R T264	[11]altingiac [A C175 D132 M198 R T264], rhodoleiac [C175 D132 M198 R T264], [9]platanac [C170 D132 M195 R T264], [10, 11, 32]daphniphyll [A C179 D132], [23, 33, 35]eucommiac [C184 R T266], [22, 25, 33]barbeyac [T266], [16, 17, 18, 18.3]leitneriac [C203 T267], [9, 17, 22, 32]didymelac [T263], [9, 10, 22, 32]buxac [T265], [8, 10, 32]simmondsiac [T265], [10, 16, 17, 20, 21, 32, 38]balanopac [D132 T263] [1, 11]cercidophyll [A C167 D132 M129 R T263], [1, 6.3, -4]eupteleac [C170 D132 M129 R T263], [1, 9]tetracentrac [C157 D132 M127 R T263], [1, 9]trochodendrac [C157 D132 M128 R T263], [9, 10, 24]myrothamnac [C176 D132 M198 T264], [10, 22]styloceratac [T265]	Hamamelidaceae: Hamamelidoideae C174; H164:1,2; M196:A-E; Z170:2	Lv Ven palmate w bracing veins between main veins, teeth distinctive; Fl half epig, ±bisex, some with linear petaloid Std.
2.16fagale	A C218 D132 M46 R T267	[10, 15, 17, 20, 21, 32, 38] balanopac [C218 D132], [18, 33, 33.1]rhoipteleac [A C209 T268], [15, 17, 18, 18.3]leitneriac [T267], [17, 18]juglandac [A C152 T268], [17, 18]myricad [A C152 T267]	Fagales C=Fagales – Balanopaceae C224, 226; H148; M48, 49; Z177, 180	Ven pinnate, Rosoid Ven, Rosoid\spiny teeth.

Cogntium & index code	Circum-scription Ref.	Boundary groups	Equivalent Taxon and Illustrations of Core Group	Description of Core Group
2.17casuarinac	A C229 D132 M39 R T267	[15, 16, 18, 18.3]leitneriac [M44], [9, 15, 22, 32]didymelac [M44], [10, 15, 16, 20, 21, 32, 38]balanopac [M43], [18.2]julianiac [M288], [16, 18]juglandac [M41], [16, 18]myricad [M40 T267]	Casuarinaceae ! H91, 92; M39	Lv scale-like in whorls on photosynthetic green twigs.
(2.18-2.21)rutan				Mostly Wd; Lv mostly w Rosoid Ven, entire or w Rosoid teeth; Receptacle below Ovy enlarged; Ovy & Fr ridged\angled\winged.
2.18 rutale	A C781 R T285	[12, 19, 22]staphyleac [C791 T285], [6, 9, 18.4]sabiac [D126], [6, 18.1, -2, 29]coriariac [M278 T285], [18.1]cneorac [M266], [14, 19, 20, 22]zygophyll [C782 T284], [14, 18.1, 19, 20]balanitac [C820 T284], [18.1, -2, 19, 20]nitrariac [C820 T284], [10, 12, 13, 14]connarac [C542], [18.4, 30]akaniac [M272], [8]physenac [T285], [32]uapacad [D126], [15, 16, 17, 18.3]leitneriac [D124 R], [16, 17]juglandac [D124 R], [16, 17]myricad [D124 R], [16, 33, 33.1]rhoipteleac [D126 R], [13, 19]**biebersteiniac [A]**	Rutaceae – Rhabdodendroideae + (Burseraceae, Meliaceae, Anacardiaceae, Sapindaceae, Aceraceae, Hippocastanaceae & Simaroubaceae: Simarouboideae)	Usu Tr; Lv usu pinnately divided, no stipules; Fl usu not showy; hypog, usu 5-merous, w pronounced nectary disk; St ±2X.
2.18.1 rutac	A C815 D126 M263 R T284	[14, 18, 19, 20]balanitac [R T284], [8]rhabdodendrac [M266 T284], [18.2]burserac [D126 M269 R T284], [18, 18.2, 19, 20]nitrariac [T284], [18.3]simarouboid [C812 D126 M266 R T284], [13, 14]surianac [D126 M267 R], [18.3, -4]kirkiac [C812 D126 M268 R], [18.3, 19]picramnioid [C812 M268 R], [20, 28, 38]irvingioid [C811 M268 R T284], [18.4, 20, 32]picrodendrac [M268], [18]cneorac [A C813 D126 R T284], [6, 18, -2, 29]coriariac [R]**,** [18.3, -4]**ptaeroxylac [A],** [40] **lissocarp [A]**	Rutaceae – Rhabdodendroideae H287, 288; M267; Z146	Aromatic, tissue w large oil cavities; Lv w uniquely simplified Ven & teeth; Cp var; Fr berry or whorl of follicles.
2.18.2 anacardiac	A C805 D126 M278 R T284	[17]julianiac [A C809 D126 M288 R T284], [18.1]burserac [A C805 R T284], [6, 18, 18.1, 29]coriariac [D126]**,** [18, 18.1, 19, 20]**nitrariac [A]**	Anacardiaceae ! C806; H30; M279; Z152	Aromatic, resin ducts throughout usu w black-drying sap; Cp 3; Fr drupe w 1 Sd.

Cogntium & index code	Circum-scription Ref.	Boundary groups	Equivalent Taxon and Illustrations of Core Group	Description of Core Group
2.18.3 meliac	A C813 D126 M270 R T284	[18.1, -4]kirkiac [C812 T284], [18.1, -4]ptaeroxylac [M271 T284], [18.1]simarouboid [A C812], [18.1, 19]picramnioid [C812], [18.4]aitoniac [C815], [15, 16, 17, 18]**leitneriac [A]**	Meliaceae – (Ptaeroxyleae & *Nymania*) C814; H208; M270:A-C, E-I; Z149	Wood & bark aromatic but w no ducts\oil cavities; St usu connate into tube; Cp 5; Fr woody capsule or drupe; Sd oft winged.
2.18.4 sapindac	A C795 D126 M282 R T285	acerac [A C803 D126 M281 R T285], hippocastanac [A C787 D126 M284 R T285], [13, 19]melianth [C794 M285 R T285], [18, 30]akaniac [C975 D126 R T285], [30]bretschneider [C794 D130 M281 R T285], [6, 9, 18]sabiac [D126 M285 R T285], [9, 11, 22, 24, 32]aextoxicad [M286] [13]stylobasiac [R T285], [30]batac [T285], [21, 30]emblingioid [R T285], [8, 30]gyrostemonac [R T285], [10, 11, 19]greyiac [M286], [18.1, 20, 32]picrodendrac [D129], [18.3]aitoniac [D126], [30]koeberlinioid [D126], [18.1, -3]ptaeroxylac [C798], [18.1, -3] **kirkiac [A]**	Sapindaceae C796; H294:4-8; M282; 154	Not aromatic; St usu 8; Cp 3\2; embryo folded; Fr berry\lobed capsule\winged achene.
2.19 geraniac	A C828 D127 M248 R T285	[30]tropaeolac [C822 D130 M250 R T286], [30]limnanthac [C822 D130 M247 R T286], [14, 18, 20, 22]zygophyll [D127 M246], [14, 18, 18.1, 20]balanitac [D127 M252], [18, 18.1, 18.2, 20]nitrariac [D127 M252], [21, 37, 40]balsaminac [C822 D127 R T286], hypseocharitac [A C826 D127 M248 T286], [25]dirachmac [C830 D127 M249 R T286], vivianiac [C830 D127 M249 R T286], [13, 18]biebersteiniac [C831 D127 M249 R T286], [22]lepidobotryac [C828 D127 M248 R T286], [12]oxalidac [C825 D127 M247 R T286], [13, 18.4]**melianth [A],** [18.1, -3]**picramnioid [A],** [37]**strasburger [A],** [10, 11, 18.4]**greyiac [A],** [11]**francooid [A],** [10, 22]**geissolomatac [A],** [13, 37]**crossosomatac [A],** [28, 28.1, -6, 37]**stachyurac [A],** [12, 18, 22]**staphyleac [A],** [28.1]**aphloioid [A]**	Geraniaceae: Geranieae C829; H154; M249; Z140	H; Lv usu palmately veined, w stipules; Fl showy, hypog, 5-merous; St 2X; Ovy deeply lobed; Styles persist as Fr beak; Fr elastically fragments into nutlets.

Cogntium & index code	Circum-scription Ref.	Boundary groups	Equivalent Taxon and Illustrations of Core Group	Description of Core Group
2.20linac	A C760 D127 M253 R T285	[28, 32]erythroxylac [C751 M254 R T286], [21, 28.4, 32, 38]humiriac [C751 D127 M254 R T286], [21, 28.2]ctenolophonac [C759 M254 R T285], [14, 18, 19, 22]zygophyll [D127 M246 R], [14, 18, 18.1, 19]balanitac [D127 M252], [18, 18.1, 18.2, 19]nitrariac [D127 M252 R], [8, 28, 37]ancistroclad [D127 R], **[28, 37]ochnac [A], [12, 28, 37]medusagynac [A], [28, 37]quiinac [A], [21, 32]phyllanthac [A], [28, 37, 38]caryocarac [A], [18.1, 28, 38]irvingioid [A], [18.1, -4, 32]picrodendrac [A], [10, 27, 28, 32, 35]rhizophorac [A], [13, 21, 32, 38]chrysobalanac [A], [10, 15, 16, 17, 21, 32, 38]balanopac [A]**	Linaceae: Lineae + Anisadenieae C=Linaceae C761; H193; M253:D-H	H; Lv w pinnate Ven, usu entire; Fl showy, hypog, 5-merous; P clawed; St connate at base into tube, 1X w Std 1X; Fr capsule.
2.21malpigh	A C768 D126 M272 R T286	[32, 38]trigoniac [A C770 D126 M273 R T286], [27.4]vochysiac [C770 D126 M274 R T286], [14]polygalac [C763 D126 M275 R T286], [10, 11, 12]tremandrac [C763 M274 T286], [12, 14, 22]krameriac [C779 D126 R T286], [18.4,30]emblingioid [C778 D126], [20, 28.2]ctenolophonac [C760], [19, 37, 40]balsaminac [C822], **[20, 32]phyllanthac [A], [32, 38]putranjivac [A], [28, 37, 38]elatinac [A], [28.1, -2]peridiscad [A], [22, 32, 38]dichapetalac [A], [22, 28.4, 32]pandac [A], [22, 28.4]lophopyxidac [A], [13, 20, 32, 38]chrysobalanac [A], [10, 15, 16, 17, 20, 32, 38] balanopac [A], [20, 28.4, 32, 38]humiriac [A]**	Malpighiaceae ! C769; H200; M273; Z142	Usu Sh w gray, stiff, 2-armed hairs; Lv opp, pinnate Ven, entire, w stipules; Fl ±showy; hypog. 5-merous; S w large paired glands; P clawed; St 2X; Cp 3; Fr dry & winged\drupes w winged stones.
(2.22-2.26) celastran				Wd; Lv usu w Celastroid Ven (simplified, 3rd level veins ±perpendicular to midrib), usu w small quick-falling stipules; Fl not showy, hypog to half epig, St 1X.

Cogntium & index code	Circum-scription Ref.	Boundary groups	Equivalent Taxon and Illustrations of Core Group	Description of Core Group
2.22celastrac	A C712 D130 M292 R T289	hippocrateac [A C716 D130 M295 R T289], stackhousiac [A C705 D130 M296 R T289], [28.2]goupiac [C714 D130 M294 R T289], [21, 28.4] lophopyxidac [C713 D130 M294 R T290], [10, 45]montiniac [D130], [30, 44]salvadorac [C705D130 M296 T290], [34]tepuianth [C706], [9, 10, 15, 22, 32]buxac [D130 M297], [8, 10, 15, 32]simmondsiac [D130 M295], [12, 29]corynocarp [C726 M292 T290], [21, 32, 38]dichapetalac [C728], [10]geissolomatac [C712 D130 T289], [23, 45]cardiopter [C705 M299 R], [12, 18, 19]staphyleac [D130 M294], [23, 24, 35]icacinac [M298 R], [9, 11, 18.4, 24, 32]aextoxicad [C723], [23, 24]medusandrac [M74 R], [10, 22, 24]balanophorac [M73], [37, 41]cyrillac [M290], [22, 28.4, 32]pandac [M292], [10, 15]styloceratac [D130 T298], [9, 15, 17, 32]didymelac [D130], [15, 25, 33]barbeyac [D130], [48.1, -2, -5] avicenniac [D130], [14, 18, 19, 20]**zygophyll [A],** [12, 14, 21]**krameriac [A],** [12, 14, 28, 34, 40]**huac [A],** [10, 11, 50]**brexioid [A],** [11, 37]**parnassioid [A],** [11, 37]**lepuropetaloid [A],** [19]**lepidobotryac [A],** [28.1]**plagiopter [A]**	Celastraceae – (Goupioideae & *Lophopyxis*) C713; H93:1,2,4,5; M293; Z88	Sh; Lv oft opp, entire\w Celastroid teeth (Rosoid-like but small w simplified Ven & long deciduous colored appendage); Fl 4-\5-merous; Ovy sunken into pronounced nectary disk; Fr drupe\ capsule w flesh-covered Sd.
2.23 aquifoliac	A C718 D130 M291 R T289	[37, 49]sphenostemonac [A C720 D130 M292 T289], [51]phellinac [C720 M292 T289], [22, 24, 35]icacinac [A C709 T289], [22, 45]cardiopter [A T289], [37, 49]paracryphiac [A T289], [22, 24]medusandrac [T289], [35, 36]**helwingiac [A],** [10]**phyllonomac [A],** [11, 43, 45, 47]**vahlioid [A]**, [37, 40]pentaphylacad [A M291], [35]**aucuboid [A],** [35]**garryac [A],** [15, 33, 35]**eucommiac [A],** [35, 37, 40]**oncothecad [A],** [10, 36]**tribelac [A],** [12, 37, 49]**bruniac [A],** [10, 35, 36, 49, 50, 51]**escallonioid [A]**	Aquifoliaceae: Iliceae C719; H42; M291; Z72	Tr\Sh; Lv entire\w teeth Celastroid-like but lacking tip appendage\teeth spiny; Fl 4-merous; Fr drupe w ±4 stones.
2.24santalale	A C673 D130 M64 R T290	[10, 35, 41]grubbiac [M67] [28]dipentodontac [C681 M66], [10, 22]balanophorac [C695 R T291], [22, 23]medusandrac [C674], [10, 27]cynomoriac [R T291], [22, 23, 35]icacinac [T290], [1, 9, 11, 28.1]**berberidopsidoid [A],** [9, 11, 27, 35]**gunnerac [A],** [9, 10, 15]**myrothamnac [A],** [9, 11, 18.4, 22, 32]**aextoxicad [A],** [1, 8, 37]**dilleniac [A]**	Santalales – (Grubbiaceae & Dipentodontaceae) C=Santales – (Balanophoraceae, Dipentodontaceae & Medusandraceae) C682, 686, 691; H196, 233, 292, 333, 334; M65, 68, 69; Z131	Wd hemiparasites w chlorophyll; Lv usu opp, entire; Fl var; Ovy ±1-chambered w ±arrested Ovu; Fr berry-\nut-like.

Cogntium & index code	Circum-scription Ref.	Boundary groups	Equivalent Taxon and Illustrations of Core Group	Description of Core Group
2.25 rhamnac	A C744 D131 M300 R T291	[9, 27, 33, 34]elaeagnac [A T291], [26]leeac [C741 D131 M303 T291], [15, 22, 33]**barbeyac [A],** [19]**dirachmac [A]**	Rhamnaceae ! C744; H278; M301; Z106	Sh; Lv sometimes w ladder-like Ven, entire\w Celastroid-like teeth, but deciduous appendage top-shaped; Fl w pronounced hypanthium & nectary disk, 5-merous; P clawed; St facing P; Fr var.
2.26vitac	A C748 D131 M302 R T291	[25]leeac [A C741 D131E303 R T291]	Vitaceae ! C749; H334, 335; M303; Z189	Wd Vi w swollen nodes; Lv ternately veined and/or divided, w Rosoid Ven & teeth; Fl in panicles opp Lv, 4-\5-merous, w nectary disk; St facing P, which fall quickly after Fl opens; Fr berry w distinctive Sd.
2.27 myrtale	A C620 D134 M345 R T283	[12, 43, 43.4]dialypetalanth [D134 M352], [27.1, -3, 34]penaeac [C633 D134 R], [37, 41]lecythidac [M354 T284], [10, 20, 28, 32, 35]rhizophorac [D134 M357 T283], [10, 29]anisophyll [D134 M359 T283], [32, 34]thymelaeac [C621 R], [9, 25, 32, 34]elaeagnac [C602 D134], [27.3]oliniac [C649 M362 R], [27.1, -3]crypteroniac [C634 D134 M348 T283], [11, 35]haloragac [D134 M363, T283], [9, 11, 24, 35]gunnerac [M364], [35, 48, 48.7]hippuridac [M365], [43.4]theligonac [M364], [10, 24]cynomoriac [M365], [27.1, -2]trapac [D134]	Myrtaceae + (Lythraceae, Sonneratiaceae, Punicaceae, Melastomataceae, Combretaceae & Onagraceae)	Usu Wd w specialized wood anatomy; Lv usu opp, entire, no stipules, Ven ±Celastroid; Fl usu showy, usu solitary\in loose cymes, w pronounced hypanthium.
2.27.1 lythrac	A C629 D134 M346 R T283	sonneratiac [A C628 D134 M352 R T283], [27.4]punicad [A D134 R T283], [27, 27.2]trapac [A M348 R], [27, 27.3]crypteroniac [R], [27.3]alzateac [C629], [27, 27.3, 34]penaeac [C633]	Lythraceae ! C630; H197; M347; Z223	Sh\H; Fl perig usu w tubular hypanthium, 4-merous; P clawed; St 2X; Fr capsule.
2.27.2 onagrad	A C638 D134 M360 R T283	[27, 27.1]trapac [C639 T283]	Onagraceae ! C646; H236, 237; M361; Z230	H; Lv ± alt, oft toothed; Fl oft in racemes, epig w stalk-like tubular hypanthium, 4-merous; St 2X, pollen connected by sticky strands; Fr usu capsule.

Cogntium & index code	Circum-scription Ref.	Boundary groups	Equivalent Taxon and Illustrations of Core Group	Description of Core Group
2.27.3 melastome	A C649 D134 M355 R T283	[27.4]memecylac [A C651 D134 M357 R T283], [27]oliniac [A D134 T283], [27.1]**alzateac [A],** [27, 27.1, 34]**penaeac [A],** [27, 27.1]**crypteroniac [A]**	Melastomataceae – Memecyloideae ! C650; H206; M355; Z226	Sh\H; Lv oft w unique Ven (several main veins bowed & converging at apex, w ladder-like finer veins); Fl half to fully epig w short tubular hypanthium, 4-\5-merous; St 2X, St w A knee-bent, opening by pore; Fr usu berry.
2.27.4 myrtac	A C639 D134 M348 R T283	[27.3]memecylac [T283], [27.1]punicad [C627 M353], [21]**vochysiac [A]**	Myrtaceae ! C640; H226; M349; Z233	Usu Tr; Lv alt in some, tissue w small oil cavities, Myrtoid Ven (combines features of Celastroid and Ven of guttifer & sapotale cg); Fl epig w cup-shaped hypanthium, 4-\5-merous; St ∞; Fr berry\capsule.
2.27.5 combretac	A C651 D134 M359 R T283		Combretaceae ! C652; H106; M360; Z228	Usu Tr\Wd Vi; Lv alt in some, usu w paired basal glands; Fl usu not showy, usu in racemes\heads, epig, hypanthium cup-\tube-shaped, 4-\5-merous, P small; St 2X; Fr ±winged nut\nutlet w 1 Sd.
(2.28-2.31) violan				Small Wd\H; Lv entire\w gland-tipped teeth, Ven Malvoid\Theoid (see below); Cp usu 2\3; Ovy 1-chambered w parietal Plac.

Cogntium & index code	Circum-scription Ref.	Boundary groups	Equivalent Taxon and Illustrations of Core Group	Description of Core Group
2.28 violale	C377 D129 M322 R T271	[29]begoniac [M338], [34] bixac [C394 M332 T272], [34]cochlosperm [C394 M332 T272], [34]cistac [C396 M330 R T272], [10, 11, 37, 40, 46]fouquieriac [T274], [40, 47]hoplestigmatac [C421], [19, 28.1, -6, 37]stachyurac [C401M327], [29]datiscad [D129 T273], [29]tetramelac [T273], [10, 11, 28.5, 37, 40, 46]fouquieriac [C420 T274], [21, 37, 38]elatinac [M334], [8, 37]dioncophyll [C408], [8, 20, 37]ancistroclad [C408], [28.1]scyphostegiac [D129 M327 R], [34, 37]sphaerosepelac [M322], [24]dipentodontac [D129 R T272], [28.4, 30]caricad [D129 M335], [12, 14, 22, 34, 40]huac [C397], [20, 37, 38]**caryocarac [A],** [18.1, 20, 38]**irvingioid [A],** [20, 37]**quiinac [A],** [12, 20, 37]**medusagynac [A],** [20, 37]**ochnac [A],** [20, 32]**erythroxylac [A],** [10, 20, 27, 32, 35]**rhizophorac [A]**	Flacourtiineae – (Stachyuraceae & Scyphostegiaceae) + ((Tamaricineae – Elatinaceae), Loasineae & Salicales)	Usu w cyanide-releasing compounds; Lv usu w Violoid teeth (vein tip thickened and dark, incurved, weak buttress veinlets, basal branches do not go to sinuses).
2.28.1 flacourtioid	A C388 D129 M323 R T271	[28.4]abatioid [A C390 M325], [19]aphloioid [C390 T271], bembiciopsidoid [M325], [1, 9, 11, 24]berberidopsidoid [T271], [28.2]erythrosperm [M324, T271], [28.6]idesioid [M325 T271], [28.4]paropsioid [C390 M325], [28.2, 30]oncoboid [A M325 T271], [28.2]pangioid [M324], [21, 28.2]peridiscad [C390 M326 R T272], [34]prockioid [A C389 M325 T271], [28]scyphostegiac [A C399 T272], trichostephanoid [M325], [22]plagiopter [C390], [34]muntingiac [C350], [28.2]lacistematac [C398 D129 M325 T271], [19, 28, 28.6, 37]stachyurac [C401 T272]	Flacourtiaceae – (Abatieae, Oncobeae, Pangieae, Paropsieae, Trichostephaneae, *Bembiciopsis, Idesia* & *Prockia*) C388; H150:2; M324: D,L,M	Small Tr\Sh; Fl usu not showy, hypog, otherwise var; St ∞; Cp 2-several; Fr berry.
2.28.2 violac	A C402 D129 M326 R T727	[28.4]**acharioid** [A], [28.1]**erythrosperm [A],** [28.1]**lacistematac [A],** [28.1, 30]**oncoboid [A],** [28.1]**pangioid [A],** [21, 28.1]peridiscad [M326 T272], [22]**goupiac [A],** [20, 21]**ctenolophonac [A]**	Violaceae ! C403; H332, 333; M327; Z113	Small Tr to H; Fl ±showy, hypog, 5-merous; St 1X; Cp 3; Fr capsule.
2.28.3 turnerac	A C409 D129 M328 R T272	[28.4]malesharbiac [C412 D129 M329 R T272]	Turneraceae ! C410; H326; M328; Z120	Sh\H; Fl ±showy, perig, 5-merous; St 1X; Cp 3, styles free; Fr capsule.

Cogntium & index code	Circum-scription Ref.	Boundary groups	Equivalent Taxon and Illustrations of Core Group	Description of Core Group
2.28.4 passiflorac	A C412 M329 R T272	[28.1]abatioid [C390] [28.3]malesharbiac [A C412 M329 R], [28.2]acharioid [C415 M330 R T272], [28.1]paropsioid [A C414 T272], [28, 30]caricad [C418 R T272]**,** [20, 21, 32, 38]**humiriac [A],** [21, 22]**lophopyxidac [A],** [21, 22, 32]**pandac [A]**	Passifloraceae C413; H244; M330; Z117	Vi; Lv palmate; Fl showy, perig, 5-merous, w crown of fringed appendages; St 1X; Cp 3; Ovy elevated on stalk; Fr berry.
2.28.5 tamaricad	C405 D129 M333 R T274	[10, 11, 28, 37, 40, 46]fouquieriac [T274], [8]frankeniac [A C407 D129 E334 R T273]	Tamaricaceae ! C405; H315; M334	Sh; *Juniper*-like plants w scale leaves; Fl sometimes in showy spikes, hypog, 4-\5-merous; St 1\2X; Cp ±3; Fr capsule w plumed Sd.
2.28.6 salicad	A C432 E45 T274	[28.1]idesioid [A C435 T274], [19, 28, 28.1, 37]stachyurac [C401]	Salicaceae ! C433; H289; M45; Z115	Tr\Sh; Lv with Salicoid teeth (Violoid-like but w spherical persistent appendage); Fl not showy, unisex, in dense, compact, flexible spikes; S small, P 0; Fr capsule w plumed Sd.
2.29cucurbitac	A C422 D129 M341 R T272	[28]begoniac [A C428 D129 R T273], [28]datiscad [A C427 D129 M338 R T273], [28]tetramelac [A R]**,** [10, 27]**anisophyll [A],** [6, 18. 18.1, -2]**coriariac [A],** [12, 22]**corynocarp [A]**	Cucurbitaceae ! C423; H116, 117; M342; Z122	Vi; Lv palmate, teeth specialized (Cucurbitoid) tipped w large cmpd glands; Fl showy, unisex, epig, 5-merous; St ±1X, fused & twisted into a single mass; Fr berry.
2.30 capparale	A C436 D130 M182 R T273	[28.1, -2]oncoboid [T273], [18.4]koeberlinioid [A C445 M183 R T273], [18.4, 21]emblingioid [A M183], [18.4]batac [A C453 D130 M193], [28, 28.4]caricad [A D129], [8, 18.4]gyrostemonac [A C453 D130], [19]tropaeolac [A D130], [19]limnanthac [A D130]**,** [18, 18.4]**akaniac [A],** [18.4]bretschneider [A D130], [22, 44]salvadorac [A D130]	Capparineae – (Capparaceae: Koeberlinieae, Emblingioideae) + (Resedineae & Moringineae) C=Capparales – *Koeberlinia* C444, 447; H69, 70, 85, 101, 276, 277; M182, 184, 187, 190; Z126, 128	H\Sh w mustard oils; Lv var; Fl ±showy, hypog, usu in racemes, 4-merous; St ±6\∞; Fr capsule\berry.

Cogntium & index code	Circum-scription Ref.	Boundary groups	Equivalent Taxon and Illustrations of Core Group	Description of Core Group
2.31 loasac	A C429 D139 M336 R T294		Loasaceae ! C430; M337	H\soft Wd, covered w rough "velcro" hairs; Fl showy, epig, in few-flowered open cymes, 5-merous; St usu ∞, sometimes w 5 petaloid Std; Fr capsule.
(2.32-2.34) malvan				Tr\Sh\H\Vi w specialized anatomy & mucilage\latex ducts; Lv oft palmate, w stipules, Ven Malvoid (finer veins rigidly arranged & organized into size levels , no "stiching" between 2nd level veins, "spider-web" pattern between main veins at base).
2.32 euphorb	C736 D128 M255 R T277	[21, 22, 38]dichapetalac [A R T278], [9, 11, 18.4, 22, 24]aextoxicad [D129 R T278], [9, 10, 15, 22]buxac [C729], [8, 10, 15]simmondsiac [C729], [21, 22, 28.4]pandac [C729 D129 R T278], [18.1, -4, 20]picrodendrac [C739 D129 R T277], [10, 11, 15]daphniphyll [M261], [27, 34]thymelaeac [T278], [18]uapacad [C739 M257 T277], [9, 15, 17, 22]didymelac [R], [21, 38]putranjivac [C739 D129 M257], [20, 21]phyllanthac [C739 M257 R T277], [33]hymenocardiac [C739 T277], **[21, 38]trigoniac [A], [13, 20, 21, 38]chrysobalanac [A], [10, 15, 16, 17, 20, 21, 38]balanopac [A], [20, 28]erythroxylac [A], [10, 20, 27, 28, 35]rhizophorac [A], [20, 21, 28.4, 38]humiriac [A]**	Euphorbiaceae: Euphorbioideae C737; H144, 145; M256: A-H, M-5; Z108	Plants w milky\clear irritating latex; Lv var, entire\w Violoid teeth; Fl usu not showy, unisex, in racemes\var clusters; P 0\5; St 1\5\∞; Ovy & Fr characteristic w 3 chambered & lobed Ovy on stalk, 3 styles branches; Fr usu capsule w 3 Sd.
2.33 urticale	A C185 D128 R T266	[15, 22, 25]barbeyac [C189 M54], [15, 23, 35]eucommiac [C184 M54], [32]hymenocardiac [D128], [16, 18, 33.1]rhoipteleac [C204], **[9, 25, 27, 34]elaeagnac [A]**	Urticales – (Rhoipteleaceae, Eucommiaceae & Ulmaceae: Barbeyoideae) C=Urticales – Barbeyaceae	Lv ±as in malvale cg but no pulvinus\star-shaped hairs, tissue w crystals; Fl not showy, usu unisex; P 0; St 1-5; Fr 1-chambered w 1 Sd.

Cogntium & index code	Circum-scription Ref.	Boundary groups	Equivalent Taxon and Illustrations of Core Group	Description of Core Group
2.33.1 ulmoid	A C193 M53 R T266	[16, 18, 33]rhoipteleac [M52], [33.2]zelkova [C192], [33.2]aphananthe [C192]	Ulmaceae: Ulmoideae C190; H327:1; M53:A-F; Z99:2	Tr w mucilage cells; Lv pinnately veined, veins end in teeth; Fl in few-flowered, loose umbels; Fr winged achene; Sd flat w straight embryo.
2.33.2 celtidoid	A C183 M53 R T266	[33.1]zelkova [C192], [33.1]aphananthe [C192 M54], [33.3, -4]**cannabac [A]**	Ulmaceae: Celtidoideae – (*Aphananthe* & *Zelkova*) H327:2,3; M53:H-L; Z99:1	Usu Tr w mucilage cells; Lv usu palmately veined; Fl in few-flowered, loose clusters; Fr drupe; Sd globose w curved embryo.
2.33.3 morac	A C195 D128 M54 R T266	[33.2, -4]cannabac [C195 M57 R T266], [33.4]cecropiac[C198 M57 T266], [33.4]fatua [C201]	Moraceae: Moroideae – *Fatua* C196; H218; M55:A-K, O; Z102	Tr w milky latex; Lv palmate\pinnate; Fl ∞ in dense, oft fleshy head-like clusters (e.g., fig); Fr multiple drupes in var shapes.
2.33.4 urticad	A C199 D128 M57 R T266	[33.2, -3]cannabac [R], [33.3]cecropiac [A C198 R T266], [33.3]fatua [C201]	Urticaceae C200; H328; M58; Z101	Usu H w clear latex, oft w stinging hairs; Ven usu palmate; Fl 1-∞ in branching to head-like clusters; Fr achene.
2.34malvale	A C341 D128 M305 R T276	[28] bixac [A R], [28]cochlosperm [A D128 R], [28]**cistac [A]**, [37]dipterocarp [A C317 D128 T276], [28, 37]sphaerosepelac [A C316 D128 T277], [37]sarcolaenac [A C316 M306 T277], [12]elaeocarp [C349 D128 M305 R T276], [37]scytopetalac [M315 T276], [27, 32]thymelaeac [A T278], [9, 25, 27, 33]elaeagnac [R], [27, 27.1, 27.3]penaeac [M317], [28.1]prockioid [C350], [28.1]muntingiac [A M306], [12, 14, 22, 28, 40]huac [D128 R T276], [13]neurad [A D128], [37]**diegodendronac [A]**, [22]**tepuianth [A]**	Malvineae C=Malvales – Elaeocarpaceae C351, 353, 357, 359; H65, 76, 134, 201, 308, 311, 322; M307, 310, 312, 313; Z91, 93, 95, 97	Plants w mucilage; Lv usu palmately veined and/or divided, usu w star-shaped hairs, w pulvinus at top of Pto, w Malvoid teeth (similar to Violoid but vein not swollen or dark); Fl ±showy, 5-merous; St usu 2X-∞, ±connate; Fr capsule.

Cogntium & index code	Circum-scription Ref.	Boundary groups	Equivalent Taxon and Illustrations of Core Group	Description of Core Group
(2.35-2.36) cornan				Lv w Celastroid Ven, entire\ w teeth as in aquifoliac cg; Fl showy only in mass, epig, w large nectary disk; S minute; P small, basally connate; Sd 1per chamber.
2.35cornale	A C668 D138 M369 R T287	nyssac [A C665 D138 M368 R T287], davidiac [A C667 D138 M368 R T287], alangiac [A C665 D138 M369 R T287], [23]garryac [A C672 D138 M370 R T287], [23]aucubac [A C669 D138 M370 T287], [36]melanophyll [C669 M370 T287], [36]griseliniac [C669 D138 M370 T288], [36]toricelliac [C670 M369 R T288], [23, 36]helwingiac [C668 D138 M370 R T288], [10, 23, 36, 49, 50, 51]escallonioid [D138], [10, 11, 12]iteoid [D138], [10, 43, 48.4]columelliac [D138], [10, 51]alseuosmiac [D138], [10, 11]pterostemonac [D138], [15, 23, 33]eucommiac [A D138], [22, 23, 24]icacinac [A D138], [10, 11, 50]stylidiac [D138], [10, 11, 50, 51]donatiac [D138], [10, 11, 36, 49]eremosynoid [D138], [11, 49]adoxac [D138], [10, 11]tetracarpaeac [D138], [10, 20, 27, 28, 32]rhizophorac [R], [11, 27]haloragac [R], [9, 11, 24, 27]gunnerac [R], [27, 48, 48.7]hippuridac [R], [10, 48, 48.7]**hydrostachydac [A],** [10, 24, 41]**grubbiac [A],** [23, 37, 40]**oncothecad [A]**	Cornaceae – (Helwingieae, Griselinieae, Torricellieae, & *Aucuba*) C668; H112; M369:A-D; Z191	Sh\Tr; Lv opp, entire, no stipules, no aromatic oils; Fl in heads\umbels\flat-topped cymes, 4-merous; St 1X. Fr drupe with separate stones.
2.36umbellifer	A C837 D127 M367 R T287	[10]pittosporac [A D127], [35]toricelliac [A D127 M369 T288], [23, 35]helwingiac [M370 T288], [35]**melanophyll [A],** [35]**griseliniac [A],** [10, 23]**tribelac [A],** [10, 11, 35, 49]**eremosynoid [A],** [10, 23, 35, 49, 50, 51]**escallonioid [A],** [10, 12, 23, 49]**bruniac [A]**	Araliaceae + Umbelliferae C=Apiales C844, 847; H35-37, 43; M371, 373, 375; Z194, 195	H\soft Wd w aromatic oils in ducts & other unique compounds; Lv w stipular base ±sheathing stem, ±ternately organized, usu toothed; Fl in distinct umbels, 5-merous; St usu 1X; Fr drupe w separate stones\Schiz.

Cogntium & index code	Circum-scription Ref.	Boundary groups	Equivalent Taxon and Illustrations of Core Group	Description of Core Group
(2.37-2.42) thean				Lv leathery, no stipules, Ven usu Theoid (w small cross veins between pinnate veins but finer veins ±random & same size), entire\w Theoid teeth (as in Violoid but shallow, w colored deciduous appendage); Fl ±showy, usu hypog; S persist & enlarge in Fr; P ±basally connate; Sd usu small, ∞.
2.37theoid	A C323 D137 M166 R T271	[1, 8, 24]dilleniac [C288 D128 M157 R T270], [11]paeoniac [C299 D128 M159 R T270], [13, 19]crossosomatac [M160 T270], [20, 28]ochnac [C313 D137 M161 T270], sauvagesiac [C313 T270], [8]asteropeiac [C322 M168, R T271], [38]bonnetiac [C322 D137 M168 R T271], [23, 35, 40]oncothecad [C331 D137 R T271], [23, 49]sphenostemonac [R], [20, 28]quiinac [C334 D137 M170 R T2271], [40]ternstroemiac [C320 D137 M168 R T271], [40]pellicier [A C323 D137 M168 R T271], [23, 40]pentaphylacad [A C323 D137 R T271], [40]tetrameristac [A C323 D137 M168 R T271], [12, 20, 28]medusagynac [C337 D137 M160 T271], [19, 28, 28.1, -6]stachyurac [D137], [20, 28, 38]caryocarac [C319 D137 M168 R T271], [19]strasburger [C313 D137 M164 R T270], [34]diegodendron [T271], [40]symplocad [A D137 R], [12]eucryphiac [M160], [41]actinidiac [C323 M160 R], [34]dipterocarp [C317 M164 R], [8, 20, 28]ancistroclad [D137 M173 T271], [8, 28]dioncophyll [D137 M163 R T271], [34]scytopetalac [C327 D137 R], [28, 34]sphaerosepelac [C315 R], [34]sarcolaenac [C315 R], [21, 28, 38]elatinac [C335], [27, 41]lecythidac [A C336 R], [8, 11, 39]nepenthac [D137 R], [8, 11, 39]droserac [D137], [11, 22]parnassioid [D137], [11, 22]lepuropetaloid [137], [41]clethrac [A R], [23, 49]paracryphiac [C336], [40]marcgraviac [A C331 D137 M169 R T271]**,** [10, 41]**roridulac [A],** [11, 41, 46]**diapensiac [A],** [22, 41]**cyrillac [A],** [40, 46]**styracad [A],** [19, 21, 40]**balsaminac [A]**, [10, 11, 28, 28.5, 40, 46] **fouquieriac [A]**	Theaceae: Theoideae C320; H319; M167:A-F; Z70	Tr\Sh; Lv oft toothed; w no resinous sap; Fl ±solitary, 5-merous; St ∞, basally connate in groups; Fr capsule.

Cogntium & index code	Circum-scription Ref.	Boundary groups	Equivalent Taxon and Illustrations of Core Group	Description of Core Group
2.38guttifer	A C337 D137 M170 R T271	[37]bonnetiac [A C322 T271], [21, 28, 37]elatinac [C335 D137 R T271], [20, 28, 37]**caryocarac [A],** [18.1, 20, 28]**irvingioid [A],** [21, 22, 32]**dichapetalac [A],** [21, 32]**putranjivac [A],** [20, 21, 28.4, 32]**humiriac [A],** [11]**podostemac [A],** [21, 32]**trigoniac [A],** [10, 15, 16, 17, 20, 21, 32]**balanopac [A],** [13, 20, 21, 32]**chrysobalanac [A]**	Guttiferae C=Clusiaceae C338; 103; M171; Z76	Tr\Sh\H; Lv opp, entire, w colored resinous dots and/or sap; specialized Ven types; Fl ±solitary\ in open cymes, usu 4-merous; St ∞, basally connate in groups; Fr capsule.
2.39sarraceniac	A C370 D137 M175 R T262	[8, 11, 37]nepenthac [C367 M176], [8, 11, 37]droserac [C367 M177] (Note: [11, 12]cephalotac is not placed here by any author, but the striking similarity of its pitcher leaves to those of this group has long been noted)	Sarraceniaceae ! H297; M176; Z74	Scapose H of wet acidic soils; Lv basal, tubular insect digestion traps; Fl showy, solitary, 5-merous; St ∞, ±basally connate; style enlarged as petaloid umbrella; Fr capsule.
2.40sapotale	C496 D136 M397 R T275	sarcosperm [A M399 T275], ebenac [A C493 D136 M400 R T275], [18.1]lissocarp [C494 D136 M401 R T275], [37, 46]styracad [A C493 D136 M400 R T275], [37]symplocad [A C493 M402 R T275], [28, 47]hoplestigmatac [M402], [12, 14, 22, 28, 34]huac [M401], [23, 35, 37]oncothecad [C331], [37]**ternstroemiac [A],** [37]**pellicier [A],** [37]**margraviac [A],** [37]**tetrameristac [A],** [23, 37]**pentaphylacad [A],** [10, 11, 28, 28.5, 37, 46]**fouquieriac [A],** [19, 21, 37]**balsaminac [A]**	Sapotaceae C497; H295, 296; M398; Z82	Tr\Sh w brown, 2-armed hairs & milky latex; Lv w Ven as in guttifer cg but alt; Fl ±showy, ±solitary, 5-merous; P connate; St 1X, facing P; Std 1X, petaloid, fringed; Fr berry w large Sd.
2.41ericale	A C479 D137 M383 R T274	epacridac [A C478 D137 M387 R T275], empetrac [AC476 D137 M386 R T275], [37]clethrac [A C471D137 M381 T274], [22, 37]cyrillac [A C469 D137 T275], pyrolac [A C460 D137 M381 R T274], monotropac [A C460 D137 M382 R T274], [37]actinidiac[A D137 T274], [11, 37, 46]diapensiac [C490 D137 M379 T275], [10, 24, 35]grubbiac [C473 D137 T275], [10, 37]roridulac [A D137], [10, 48.2]byblidac [D137], [27, 37]**lecythidac [A]**	Ericaceae ! C480; H140, 141:8,9; M384; Z78, 79:1,2	Sh\Tr w peeling bark, no latex\resin; Lv w small teeth and/or rolled under margins; Fl ±showy, in racemes\umbels, 5-merous; P oft fused into tube; St 2X-∞, opening by pore; Fr capsule\berry.
2.42primulale	A C517 D136 M391 R T275	myrsinac [A C507 D136 M390 R T275], theophrastac [A C507 D136 M389 R T275], [8]plumbage [D136 M394 R], [8]polygonac [D136], aegiceratac [A D136 R]	Pimulaceae ! C518; H266, 291; M392	Usu H; Lv usu subsucculent w obscure Ven; Fl usu showy in racemes\umbels, 5-merous; P distinctly connate; St ±1X, facing P; Fr capsule w 1 chamber and free-central Plac.

Cogntium & index code	Circum-scription Ref.	Boundary groups	Equivalent Taxon and Illustrations of Core Group	Description of Core Group
(2.43-2.51) sympetalous				Vegetatively var; Fl usu showy, 4-\5-merous; Both S and P strongly connate, oft ±tubular; St ±1X, adnate to P-tube.
(2.43-2.44) contorted				Lv opp; Fl in cymes\heads; P usu twisted together (contorted) in bud, usu forming long tube & spreading lobes at top.
2.43 gentianale	A D139 M405 R T292	[43.2, 48, 48.7]retziac [C869 D139], [45, 51]menyanth [D139 M410 R T293], [12, 27, 43.4]dialypetalanth [T293], [10, 35, 48.4]**columelliac [A],** [43.2, 49]**desfontainiac [A],** [11, 23, 45, 47]**vahlioid [A]**	Gentianales – Menyanthaceae C=Gentianales + Rubiaceae – Retziaceae	Wood anatomy as in myrtale cg, alkaloids oft produced; Lv entire w Myrtoid Ven, club-shaped glands in crevice at base of Pto (& base of S).
2.43.1 gentianac	A C971 D139 M408 R T292	saccifoliac [A C875 T292], [43.2]**potalioid [A]**	Gentianaceae ! C872; H153; M409; Z245	H, mycorrhizal, sometimes parasitic, no latex; Fl hypog; Cp 2; Fr usu 1-chambered capsule w parietal Plac.
2.43.2 loganioid	A C865 D139 M406 R T292	antoniod [C867 D139 M407 T292], strychnoid [C867 D139 M407 T292], [43, 49]desfontainiac [C865 M408 R T292], [43.3, -4]gelsemioid [C866 M406], [43.3, 44, 48]plocosperm [T292], [48.5, -7]buddlejoid [D139 R], [43, 48, 48.7]retziac [R], [43.1]potalioid [C867 D139 M408 T292], [43.4]spigelioid [A C867 D139 M407 R T292], [43.4] pagameoid [R], [43.4, 48.6]henriqueziac [R], [44, 48, 48.7]polypremum [C947]	Loganiaceae: Loganieae H195:3; M407:B	Wd, no latex; Lv w fused stipules between the paired Pto (interpetiolar); Fl hypog; Cp 2; Fr usu capsule.
2.43.3 apocynac	A C861 D139 M412 R T292	[43.2, 44, 48]plocosperm [C878 R T292], [43.2, -4]**gelsemioid [A]**	Apocynaceae + Asclepiadaceae ! C877, 880; H38-40; M412, 415; Z240, 241	Wd\H w toxic milky latex; Lv w no stipules; Fl hypog; St forming sticky adherent cone around enlarged style head; Cp 2; Fr usu paired follicles; Sd w fleshy aril\ plume

Cogntium & index code	Circum-scription Ref.	Boundary groups	Equivalent Taxon and Illustrations of Core Group	Description of Core Group
2.43.4 rubiac	A C995 D139 M417 R T292	[27]theligonac [A C992 D139 R T292], [43.2, -3]**gelsemioid [A]**, [43.2]spigelioid [R], [43.2, 48.6]henriqueziac [A C997 R], [43.2] pagameoid [R], [12, 27, 43]**dialypetalanth [A]**	Rubiaceae – (*Gaertnera* & *Pagamea*) ! C996; H285, 286; M419; Z237	Wd\H, no latex; Lv w interpetiolar stipules (see loganioid cg); Fl epig; Cp usu 2; Fr var.
2.44oleac	A C948 D138 M404 R T293	[48.2]nyctanthac [T275], [43.2, 48, 48.7]**polypremum [A],** [48, 48.1]**tetrachondrac [A]**, [22, 30]salvadorac [D130 R], [43.2, -3, 48]**plocosperm [A],** [49]**carlemannioid [A]**	Oleaceae ! C949; H234, 235; M404; Z247	±Wd; Lv w no stipules; oft pinnately divided, entire\w Rosoid teeth; Ven Rosoid\ Myrtoid, lower surface w green flat glands; P4\0; St 2; Cp 2; Fr var, usu w 1 Sd.
(2.45-2.47) plicate				H\soft Wd; Lv w no stipules, usu entire, Ven var; Fl in cymes or heads, hypog, usu 5-merous, P often contorted but also pleated (plicate) w strong fold lines along middle & at fused margins.
2.45 convolvulale	A R	[43, 51]menyanth [C903], [45.2]duckeodendrac [C891 M447 T296], [22, 23]cardiopter [D131], [10, 22]**montiniac [A],** [47]**hydroleoid [A],** [11, 23, 43, 47]**vahlioid [A],** [50]**sphenocleac [A]**	Convolvulineae – (Fouquieriaceae & Polemoniaceae) + (Solanaceae & Nolanaceae) C=Solanales – (Duckeodendraceae, Hydrophyllaceae, Menyanthaceae & Polemoniaceae)	Vascular bundles w internal phloem; alkaloids usu produced; Fl usu funnel-shaped to flat wheel-shaped; Cp 2.
2.45.1 convolvulac	A C895 D131 M427 R T294	cuscutac [C900 D131 M429 R T294]	Convolvulaceae – Cuscutoideae C=Convolvulaceae C896; H109; M428:A,B,D; Z216	Usu Vi w latex; Fr capsule w 4 rounded-angular Sd; Cot folded.

Cogntium & index code	Circum-scription Ref.	Boundary groups	Equivalent Taxon and Illustrations of Core Group	Description of Core Group
2.45.2 solanac	A C892 D131 M444 R T295	nolanac [A C892 D131 M444 R T295], goetzeac [A C895 D131 M447 T295], [45]duckeodendrac [A R]	Solanaceae –Goetzeinae C893; H306, 307; M446; Z214	H\lank Sh w no latex; Fr berry\capsule w ∞ flat Sd; Cot straight.
2.46polemoniac	A C903 D131 M426 R T294	[10, 11, 28, 28.5, 37, 40]fouquieriac [M427 R], [47]hydrophyll [C906 M430],[45]hydroleoid [M430 T294], [37, 40]**styracad [A],** [11, 37, 41]**diapensiac [A]**	Polemoniaceae ! C904; H261; M426; Z221	Primary xylem in continuous ring; Lv oft opp; Fl in ± flat-topped cymes; narrowly tubular w spreading P lobes at top to funnel-shaped; Cp 3; Fr capsule; Sd ±∞, rounded, mucilaginous.
2.47borage	C917 D131 M431 R T294	[46]hydrophyll [A C920 D131 M430 R T294], [45]hydroleoid [M431 T294], lennoac [C916 D131 M434 R T295], [28, 40]hoplestigmatac [D131 R T295], [11, 23, 43, 45]**vahlioid [A]**	Boraginaceae ! C918; H66, 67; M432; Z219	Plants covered w rough, calcified hairs; Fl in spike-like 1-sided cymes\ open cymes\heads; tubular w spreading lobes\funnel-shaped; Cp 2; Fr Schiz w 4 nutlets\drupe w 4 stones; Sd 1 per chamber.
2.48bilabiate	A D139	[44, 48.1]tetrachondrac [A M438 T295], [10, 35, 48.7]hydrostachydac [C928 T298], [27, 35, 48.7]hippuridac [C928 T298], [48.7]callitrichad [A C928 D140 M438 T295]**,** [48.4, -6, -7]**veronicoid [A],** [43.2, 44, 48.7]**polypremum [A]**, [43, 48.7]retziac [C869 T296], [48.2, -7]myoporac [M467 R], [48.2, -3]phrymac [M467]**,** [43.2, -3, 44]**plocosperm [A]**	Solanineae – (Buddlejaceae, Columelliaceae, Duckeodendraceae, Henriqueziaceae, Nolanaceae & Solanaceae) + Verbenineae – (Callitrichaceae, *Tetrachondra* & Verbenaceae: Nyctanthoideae)	Lv usu opp, entire\w Rosoid teeth,Ven Rosoid, no stipules; Fl hypog, (|), usu 5-merous; P imbricate in bud, 2 in upper lip + 3 in lower lip (sometimes apparently × because upper lip = 3 other lobes); St usu 4 (2 long + 2 short); Cp 2; style w 2 branches, usu persists in Fr.
2.48.1 labiate	C924 D140 M438 R T295	[48.2, -7]**stilboid [A]**, [48.3, -7, -8]**mimuloid [A]**, [44, 48]tetrachondrac [C926 D140 R]**,** [48.3, -6, -7]**paulowniac [A]**, [48.2]**viticoid [A]**, [48.2]**caryopter [A]**, [48.2]**symphorematoid [A]**	Labiatae – *Tetrachondra* ! C925; H179,180; M439; Z266	Usu H w square stems; Infl cymes in false spikes\heads; style falls w P; Ovu attached laterally to false Ovy partitions; Fr usu dry Schiz w 4, 1-seeded nutlets.

Cogntium & index code	Circum-scription Ref.	Boundary groups	Equivalent Taxon and Illustrations of Core Group	Description of Core Group
2.48.2 verbenoid	A D140 M436 R T295	[48, 48.3]phrymac [C923 M467 R S T295], [48.1]viticoid [M435 R T295], [48.1]caryopter [M437 R T295], [48.1]symphorematoid [C923 M437 R T295], chloanthoid [C923 M436 R T295], [48.7]stilboid [C923 D140 M437 R T295], [22, 48.5]avicenniac [C923 R M437 T295], [44]nyctanthac [C923 M437 R T295], [48.6, -7]**martynioid [A],** [48, 48.7]**myoporac [A],** [10, 41]**byblidac [A]**	Verbenaceae: Verbenoideae –Monochileae C921; H330; M436: A,E,F,L; Z263	Sh\H w square stems; Fl ±in spikes\heads, oft narrowly tubular with spreading lobes & lips poorly defined; Ovu attached to margins of false Ovy partitions; Fr Schiz w 1-4 nutlets\drupe; Sd usu 1/chamber.
2.48.3 orobanchac	A D140 C957 M465 R T297	[48.7]rhinanthoid [A C959 M465 R], [48.7]**buchneroid [A],** [48.1, -7, -8]**mimuloid [A],** [48.1, -6, -7]**paulowniac [A],** [48, 48.2]**phrymac [A]**	Orobanchaceae ! C958; M465	H, root parasites w no chlorophyll; Lv scale-like; Fl usu in spikes; Ovy & Fr w 1 chamber w parietal Plac; Fr capsule w ∞ small Sd.
2.48.4 gesneriad	A C960 D140 M462 R T297	[10, 35, 43]columelliac [M464], [48.6, -7]**calceolarioid [A],** [48, 48.6, -7]**veronicoid [A]**	Gesneriaceae ! C961; H155, 156; M462	H\small Wd, oft epiphytes, usu covered by calcified and/or glandular hairs; cymes w 1-2 Fl; St w A coherent in pairs; Ovy & Fr w 1 chamber w parietal Plac; Fr capsule w ∞ small Sd.
2.48.5 acanth	A C963 D140 M456 R T297	mendonciac [C966 D140 M458 R T297], [48.7]nelsoniac [C966 M458 R T297], thunbergiac [C966 D140 M458 R T297], [48.6]**pedalioid [A]**, [22, 48.1, -2]**avicenniac [A]**	Acanthaceae: Acanthoideae C964; H23:1, 24; M457: A-I, L-T; Z260	H\small Wd; Lv contain crystals; Fl in spikes oft w showy bracts; St 4\2; Fr club-shaped explosive capsule w several flat, oft mucilaginous Sd seated on hook-shaped supports.
2.48.6 bignoniac	A C968 D140 M453 R T297	[43.2, -4]henriqueziac [D139 M456], [48.2, -7]martynioid [C945 R T297], [48.5, -7]pedalioid [C945 R T297], [48.7]schlegeliac [A C971 M454], [48.1, -3, -7]paulowniac [C970 M455 R T297], [48.7]scrophularioid [T297], [48.4, -7]**calceolarioid [A],** [48, 48.4, -7]**veronicoid [A],** [43.2, 48.7]**buddlejoid [A]**	Bignoniaceae – (*Paulownia* & *Schlegelia*) ! C969; H63; M545; Z249	Tr\woody Vi; Lv usu divided; St w A oft coherent in pairs, 1 Std (5th St) oft present; Fr woody capsule w axile bilobed Plac; Sd usu ∞ & winged.

Cogntium & index code	Circum-scription Ref.	Boundary groups	Equivalent Taxon and Illustrations of Core Group	Description of Core Group
2.48.7 antirrhinoid	A D140 M451 R T297	globulariac [A C954 M453 R T296], selage [A C954 M452 R T297], verbascoid [A C953 M450 T297], [48.6]scrophularioid [A C951 M450 R T297], [43.2, 48.6]buddlejoid [A C940 M448 R T296], [43.2, 44, 48]polypremum [C947], [48, 48.4, -6]veronicoid [A C953 M452 T297], [48, 48.2]myoporac [A C955 T297], [48.3]rhinanthoid [C953 M452 T297], [48.3]buchneroid [M542], [48.1, -3, -6]paulowniac [C971], [48.1, -3, -8]mimuloid [M450], [48.4, -6]calceolarioid [A C953 M451 T297], [48.2, -6]martynioid [M460 T297], [48.5, -6]pedalioid [M461 T297], [48.6]schlegeliac [C971], [48.5]nelsoniac [C966 M458], plantage [C935 M471 R T297], [48]callitrichad [A C929], [27, 35, 48]hippuridac [A C929], [10, 35, 48]hydrostachydac [C929], [43, 48]**retziac [A],** [48.1, -2]**stilboid [A]**	Scrophulariaceae: Antirrhineae H302:4; M449:C, 450:F-H; Z251:3	H; Lv sometimes alt; St 4\2, sometimes w 1 Std; style not branched; Fr capsule w ∞ angular Sd.
2.48.8 lentibulariac	C973 D140 M465 R T297	[48.1, -3, -7]mimuloid [M466]	Lentibulariaceae ! C973; H190, 191; M466; Z257	Scapose H, aquatic\in acidic wet soils, insectivorous w sticky\trap Lv; Fl solitary, usu spurred; St 2; Ovy & Fr 1-chambered w free-central Plac; Fr capsule w ∞ minute Sd.
2.49dipsacale	A C1002 D138 M472 R T293	[50, 51]calycerac [C1018 D138 R], [44]carlemannioid [C1006 M474 T293], [11, 35]adoxac [A C1011 R T293], [10, 12, 23, 36]**bruniac [A]**, [43, 43.2]**desfontainiac [A],** [23, 37]**paracryphiac [A],** [10, 11, 35, 36]**eremosynoid [A],** [10, 23, 35, 36, 50, 51]**escallonioid [A],** [23, 37]**sphenostemonac [A]**	Dipsacales – (Adoxaceae, Caprifoliaceae: *Carlemannia* & *Silvanthus*) ! C1007, 1012, 1014; H87, 130, 219, 329, 331; M473, 476, 477; Z199, 201	H\soft Wd; Lv opp, oft divided, entire\w Rosoid teeth, Ven Rosoid, oft w stipules; Fl in cymes\heads, half to fully epig, 5-merous; S very small; P usu valvate in bud; St 1X; Cp 3-5; Ovu 1/chamber; Fr oft w 1 Sd, var forms.
2.50campanulac	A C983 D131 M480 R T298	lobeliac [A C985 D131 M481 R T298], pentaphragmatac [A C981 M482 R T298], [45]sphenocleac [C976 D131 M482 R T298], [10, 11, 35]stylidiac [A C976 M483 T299], [10, 11, 35, 51]donatiac [C976 M483 T299], [49, 51]goodeniac [A C976 M482 R T299], [51]brunoniac [A C976 M483 R T299], [49, 51]calycerac [A C1018 M484 T300], [10, 11, 22]**brexioid [A],** [10, 23, 35, 36, 49, 51]**escallonioid [A]**	Campanulaceae – Lobelioideae H84; M480:A, C-G; Z212: 1-2	H\soft Wd, oft w latex; Lv alt, entire, Ven & teeth var, no stipules; Fl in racemes, half to fully epig, 5-merous; P valvate in bud; St 1X, coherent as tube through which style pushes pollen; Fr capsule w ∞ Sd.

Cogntium & index code	Circum-scription Ref.	Boundary groups	Equivalent Taxon and Illustrations of Core Group	Description of Core Group
2.51composite	A C1021 D128 M486 R T300	[49, 50]calycerac [A M484 T300], [50]**goodeniac [A],** [51]**brunoniac [A],** [43, 45]**menyanth [A],** [10, 35]**alseuosmiac [A],** [10, 23, 35, 36, 49, 50]**escallonioid [A],** [23]**phellinac [A]**, [10, 11, 35, 50]**donatiac [A]**	Compositae C=Asteraceae C1022; H46-51; M485-487; Z204, 208, 210	H\soft Wd, some w latex; Lv var, no stipules; Fl in unique characteristic false-flower heads with S-like bracts surrounding miniature flowers, epig, 5-merous; P valvate in bud; St 1X, coherent as tube through which style pushes pollen; Fr achene w 1 Sd.

Appendix B. Illustrations of Secondary Cognita.

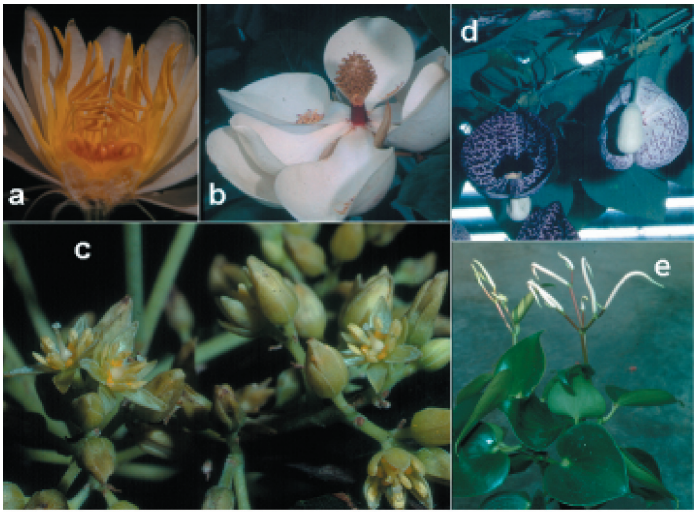

Figure B1. Magnoliid cg. a: **nymphaeale cg,** *Nymphaea sp.* (Nymphaeaceae); b: **magnoliale cg**, *Magnolia grandiflora* (Magnoliaceae); c: **laurale cg,** *Persea americana* (Lauraceae); d: **aristolochiac cg**, *Aristolochia sp*. (Aristolochiaceae); e: **piperale cg,** *Peperomia sp*. (Piperaceae). Photos by author.

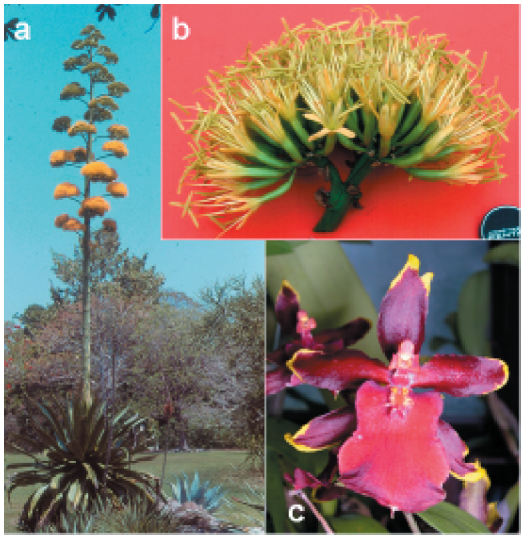

Figure B2. Liliiflore cg. a-b: **lilian cg**, *Agave sp*. (Agavaceae), a. plant in flower, b. part of flower cluster; c: **orchid cg**, *Oncidium* × *Odontoglossum* hybrid sp. (Orchidaceae). Photos by author.

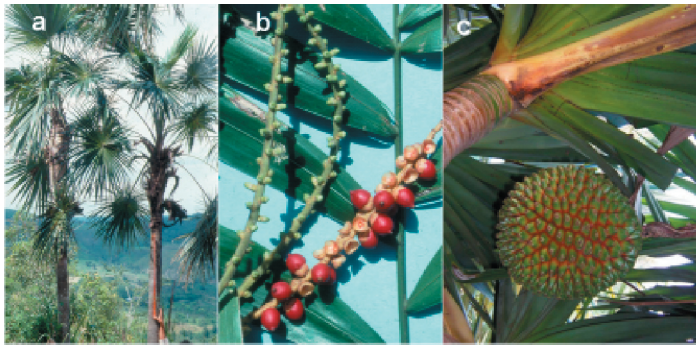

Figure B3. Palmiform cg. a: **palm cg**, *Coccothrinax sp.* (Arecaceae), growth habit, Dominican Republic; b: **palm cg**, *Ptychosperma sp.* (Arecaceae), portions of leaf, flowering branches, and fruiting branch, photos by author; c: **pandan cg**, *Pandanus utilis* (Pandanaceae), stems, leaves, and developing fruiting cluster, photo from Wikipedia.

Figure B4. Farinose cg. a: **bromiliad cg**, *Bromelia pinguin* (Bromeliaceae), basal leaves and inflorescence; b: **graminoid cg**, *Cladium jamaicense* (Cyperaceae), portion of inflorescence and upper leaves. Photos by author.

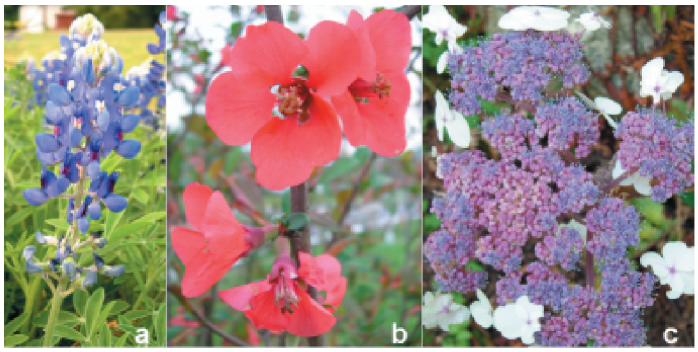

Figure B5. Rosan cg. a: **legume cg**, *Lupinus texensis* (Fabaceae); b: **rosac cg**, *Chaenomeles japonica* (Rosaceae); c: **hydrangeoid cg,** *Hydrangea sargentiana* (Hydrangeaceae). Photos by author.

Figure B6. Fagan cg. a: **fagale cg**, *Quercus shumardii* (Fagaceae), young leaves and staminate catkins, photo by author; b: **casuarinac cg**, *Casuarina equisetifolia* (Casuarinaceae), twig with dried leaves curled back, and ripe cluster of nuts, photo from Wikipedia.

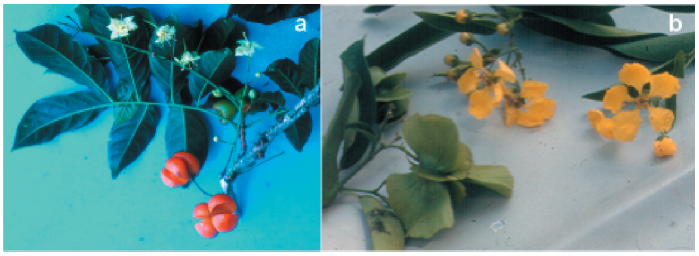

Figure B7. Rutan cg. a: **rutale cg**, *Harpullia arborea* (Sapindaceae), leaves, flowers, and fruits; b: **malpigh cg**, *Stigmaphyllon sp.* (Malpighiaceae), leaves, flowers, and 3-winged fruits. Photos by author.

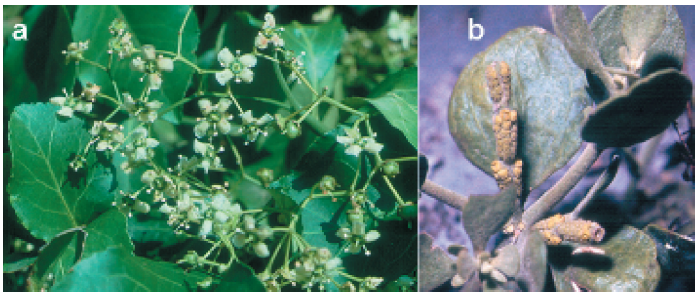

Figure B8. Celastran cg. a: **celastrac cg**, *Euonymus sp*. (Celastraceae), leaves and flowers; b: **santalale cg**, *Phoradendron sp*. (Viscaceae), parasitic on tree trunk, showing leaves and inflorescences. Photos by author.

Figure B9. Violan cg. a: **violale cg**, *Oncoba spinosa* (Flacourtiaceae), flower in longisection; b: **capparale cg**, *Lunaria annua* (Brassicaceae), flowers and developing fruits.; c: **cucurbitac cg**, *Momordica charantia* (Cucurbitaceae), mature fruit splitting along three major valves and showing seeds with parietal placentation. Photos by author.

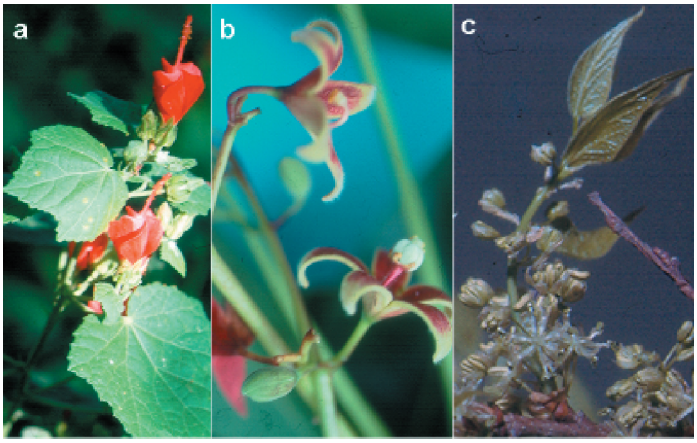

Figure B10. Malvan cg. a: **malvale cg**, *Malvaviscus arboreus* (Malvaceae); b; **malvale cg**, *Sterculia foetida* (Sterculiaceae), closeups of staminate (above) and pistillate (below) flowers; c: **urticale cg**, *Celtis laevigata* (Ulmaceae), closeup of flowers and young leaves. Photos by author.

Figure B11. Cornan cg. a: **umbellifer cg**, *Trachymene caerulea* (Apiaceae); b: **cornale cg**, *Cornus canadensis* (Cornaceae), fruiting plants on forest floor. Photos by author.

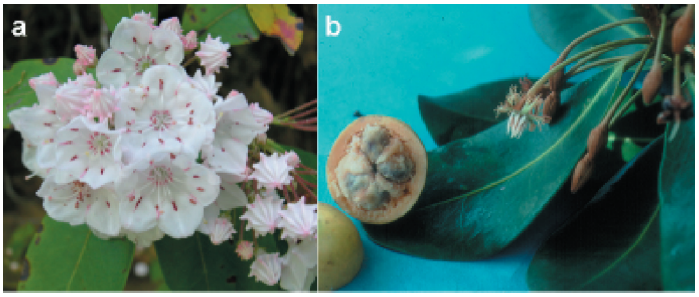

Figure B12. Thean cg. a: **ericale cg**, *Kalmia latifolia* (Ericaceae); b: **sapotale cg**, *Mimusops balata* (Sapotaceae), flowering branch and fruit in cross-section. Photos by author.

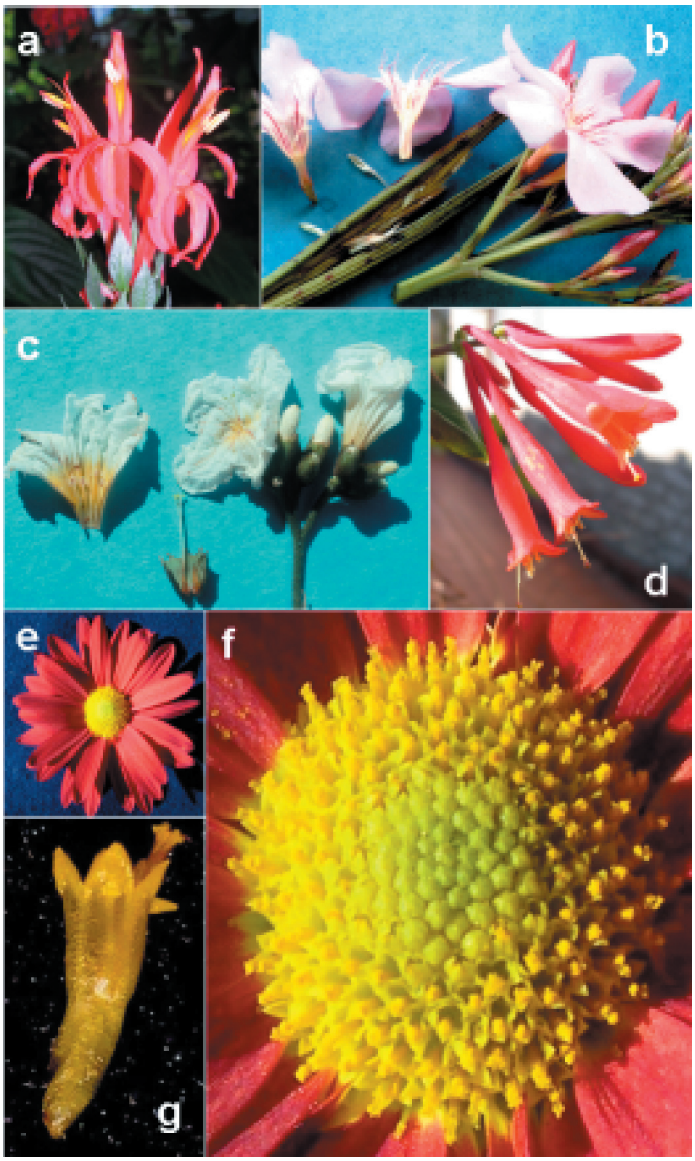

Figure B13. Sympetalous cg. a: **bilabiate cg,** *Justicia coccinea* (Acanthaceae), terminal portion of spike, note each flower with upper lip of two strongly fused petals and lower lip with three long lobes; b: **contorted cg: gentianale cg** *Nerium oleander* (Apocynaceae), portion of inflorescence, flower sectioned lengthwise, and fruit split open to show seeds; c: **plicate cg: borage cg**, *Cordia boissieri* (Boraginaceae), portion of inflorescence, petal tube removed from sepal tube, they and ovary split lenthwise; d: **dipsacale cg**, *Lonicera sempervirens* (Caprifoliaceae); e-g: **composite cg**, *Chrysanthemum morifolium.* (Asteraceae), e. whole flowering head showing yellow disk florets in center and red ray florets around outside; f. closeup of cluster of disk florets; g. closeup of individual disk floret showing petals fused into a tubular flower, note style and tip of stamens protruding from tubular part of flower. Photos by author.

Appendix C. Taxonomic equivalents of cognitum boundary groups and published illustrations. Conventions and symbols same as in Appendix A, column 4.

Boundary Group Name	Formal Taxon included	Illustrations
abatioid	Flacourtiaceae:Abatieae	M324:K
acerac	Aceraceae !	C802; H293; M281; Z156
acharioid	Achariaceae !	H24, 25
achatocarp	Achatocarpaceae !	M83:N,O
acorac	Araceae:Acoreae	M592:A-C
actinidiac	Actinidiaceae !	C324; M161
adoxac	Adoxaceae !	M475
aegiceratac	Myrsinaceae:Aegiceratoideae	M390:F-H
aextoxicad	Aextoxicaceae !	
agdestidac	Phytolaccaceae:Agdestideae	
aitoniac	Meliaceae:*Nymania* (=*Aitonia*)	
akaniac	Akaniaceae !	
alangiac	Alangiaceae !	
aletroid	Liliaceae:Aletroideae	Correll & Correll 1982, p. 298
allioid	Liliaceae:Allioideae	M518:H; Z287
alseuosmiac	Caprifoliaceae:*Alseuosmia*	
alstroemerioid	Liliaceae:Alstroemerioideae	Z276
altingiac	Hamamelidaceae:Liquidambaroideae	M196:E-K; Z170:1
alzateac	C=Lythraceae:*Alzatea* (not in M)	
amborell	Amborellaceae !	
ancistroclad	Ancistrocladaceae !	H31, 32
anisophyll	Rhizophoraceae:Anisophylleeae	H32
antonioid	Loganiaceae:Antonieae	M407:A,C,L
aphananthe	Ulmaceae:*Aphananthe*	
aphanopetalum	C=Cunoniaceae:*Aphanopetalum* (not in M)	
aphloioid	C=Flacourtiaceae:*Aphloia* (not in M)	
aphyllanthoid	Liliaceae:Aphyllantheae	
aponogetonac	Aponogetonaceae !	H344; M507:A-F
asphodeloid	Liliaceae:Asphodeleae	
astelioid	Liliaceae:Milliganieae	
asteropeiac	Theaceae:Asteropeioideae	
astilboid	Saxifragaceae:Astilbeae	M:202:A
aucubac	Cornaceae:*Aucuba*	H52; M269:E-G
austrobaileyac	Austrobaileyaceae !	
avicenniac	Verbenaceae:Avicennioideae	M436:I
balanitac	Zygophyllaceae:Balanitoideae	
balanopac	Balanopaceae !	M43
balanophorac	Balanophoraceae !	H54; M73

Appendix C. Continued.

Boundary Group Name	Formal Taxon included	Illustrations
balsaminac	Balsaminaceae !	C835; H55, 56; M287
barbeyac	Ulmaceae:Barbeyoideae	
basellac	Basellaceae !	H56, 57; M91:L-R
batac	Bataceae !	C457; H58; M193
bauerac	Saxifragaceae:Baueroideae	
begoniac	Begoniaceae !	H59; M334; Z124
bembiciopsidoid	Flacourtiaceae:*Bembiciopsis*	
berberidopsidoid	*Berberidopsis* (not in M or C)	
biebersteiniac	Geraniaceae:Bierbersteinieae	
bixac	Bixaceae C=Bixaceae – (*Amoreuxia* + *Cochlospermum*)	H64
bonnetiac	Theaceae:Bonnetioideae	
bretschneider	Bretschneideraceae !	
brexioid	Saxifragaceae:Brexioideae	
brunelliac	Brunelliaceae !	
bruniac	Bruniaceae !	
brunoniac	Brunoniaceae !	M483:C-E
buchneroid	Scrophulariaceae:Buchnereae	Z251:2
buddlejoid	Buddlejaceae C=Buddlejaceae – *Polypremum*	C946; H73; M448
burmanniac	Burmanniaceae !	H355, 356; M539:A-G
burserac	Burseraceae !	H74; M269
butomac	Butomaceae	M502:K-O
buxac	Buxaceae:Buxeae	C732; H75; M297
byblidac	Byblidaceae	
calceolarioid	Scrophulariaceae:Calceolarieae	M450:H
callitrichad	Callitrichaceae !	C933; H79, 80; M438
calycerac	Calyceraceae !	H82; M483:H,I
canellac	Canellaceae !	Correll & Correll 1982, p. 533
cannabac	Moraceae:Cannaboideae C=Cannabaceae	C194; M55L-N,P
cannac	Cannaceae !	C1184; H357; M612:B-F; Z333
cardiopter	Cardiopteridaceae !	
caricad	Caricaceae !	C416; M336
carlemannioid	Caprifoliaceae: *Carlemannia* + *Silvanthus*	
caryocarac	Caryocaraceae !	
caryopter	Verbenaceae:Caryopteridoideae	
cecropiac	Moraceae:Conocephaloideae C=Cecropiaceae	
centrolepidac	Centrolepidaceae – Trithurieae	M558:F-M
cephalotac	Cephalotaceae !	H94; M201

Appendix C. Continued.

Boundary Group Name	Formal Taxon included	Illustrations
ceratophyll	Ceratophyllaceae !	H95; M146
cercidophyll	Cercidophyllaceae	C168; M128:E-G
chloanthoid	Verbenaceae:Chloantheae	
chloranthac	Chloranthaceae !	H98; M150
chrysobalanac	Chrysobalanaceae !	C581; H99
circaeaster	Ranunculaceae:Kingdoniinae	
cistac	Cistaceae !	C395; H100, 101; M331; Z111
clethrac	Clethraceae !	C470; H102; M382:A-C
cneorac	Cneoraceae !	
cochlosperm	Cochlospermaceae C=Bixaceae: *Amoreuxia* + *Cochlospermum*	C392; H105
colchicoid	Liliaceae:Wurmbaeoideae	H358
columelliac	Columelliaceae !	
connerac	Conneraceae !	H107, 108
convollarioid	Liliaceae:Convollarieae + Polygonateae	M516:E-G, 518:E,G
coriariac	Coriariaceae	H110, 111; M278
corsiac	Corsiaceae	M539:H,I
corynocarp	Corynocarpaceae !	C725
costac	Zingiberaceae:Costoideae C=Costaceae	C1181; H362; Z330, 331
crassulac	Crassulaceae !	C567; H113, 114; M199
crossosomatac	Crossosomataceae !	C579
crypteroniac	Crypteroniaceae !	
ctenolophonac	Linaceae:Ctenolophonoideae + Hugonieae C=Hugoniaceae	H168; M253:A-C
cuscutac	Convolvulaceae:Cuscutoideae C=Cuscutaceae	M428:C,E-G
cyanastrac	Cyanastraceae	C1207; M528
cyclanth	Cyclanthaceae !	C1088; H362, 363; M590
cynomoriac	Cynomoriaceae	
cyrillac	Cyrillaceae !	C467; H121
daphniphyll	Daphniphyllaceae !	
dasypogonoid	Xanthorrhoeaceae:Dasypogoneae	
datiscad	Datiscaceae:Datisceae	C426; M338:B-F
davidiac	Davidiaceae	
davidsoniac	Davidsoniaceae !	C549
degeneriac	Degeneriaceae !	C42; M111
desfontainiac	Desfontainiaceae C=Loganiaceae: *Desfontainia*	
dialypetalanth	Dialypetalanthaceae !	
diapensiac	Diapensiaceae !	C489; H124; M380

Appendix C. Continued.

Boundary Group Name	Formal Taxon included	Illustrations
dichapetalac	Dichapetalaceae !	C727; H125; M318
didymelac	Didymelaceae !	
diegodendron	C=Ochnaceae: *Diegodendron* (not in M)	
dilleniac	Dilleniaceae !	C297; H127, 128; M158
dioncophyll	Dioncophyllaceae !	
dipentodontac	Dipentodontaceae !	
dipterocarp	Dipterocarpaceae !	H131; M165
dirachmac	Geraniaceae:Dirachmeae	
donatiac	Stylidiaceae:Donatioideae C=Donatiaceae	
doryanth	Agavaceae:Doryantheae	
dracaenoid	Agavaceae:Cordylineae + Dracaeneae p.p.	M526:A,B; Z284:2
droserac	Droseraceae !	C375; H132, 133; M177
duckeodendrac	Duckeodendraceae !	
ebenac	Ebenaceae !	C500; M400
ecdeiocoleac	Restionaceae:Anarthrieae	
elaeagnac	Elaeagnaceae !	C607; H135, 136; M321
elaeocarp	Elaeocarpaceae – *Muntingia* C=Elaeocarpaceae	C348; H137; M305:C,D
elatinac	Elatinaceae !	H138; M335
emblingioid	Capparaceae:Emblingioideae	
empetrac	Empetraceae !	C475; H141:10-12; M387
epacridac	Epacridaceae !	C477; M382:D-G
eremorsynoid	Saxifragaceae:Eremorsynoideae	
eriocaul	Eriocaulaceae !	C1117; H367; M556; Z344
eriosperm	Liliaceae:Bowieeae	
erythrosperm	Flacourtiaceae: *Erythrospermum*	
erythroxylac	Erythroxylaceae	C755; M255
escallonioid	Saxifragaceae:Escallonioideae	
eucommiac	Eucommiaceae !	C183
eucryphiac	Eucryphiaceae !	C544
eupomatiac	Eupomatiaceae !	C45
eupteleac	Eupteleaceae !	C169
fatua	Moraceae: *Fatua*	Correll & Correll 1982, p. 417
flagellariac	Flagellariaceae: *Flagellaria* C=Flagellariaceae	H368
fouquieriac	Fouquieriaceae !	C419
francooid	Saxifragaceae:Francooideae	
frankeniac	Frankeniaceae !	H151
garryac	Garryaceae !	C671

Appendix C. Continued.

Boundary Group Name	Formal Taxon included	Illustrations
geissolomatac	Geissolomataceae !	
gelsemioid	Loganiaceae:Gelsemieae	C866; Z235
geosiridac	Geosiridaceae	
gisekioid	Molluginaceae:Gisekieae	
globulariac	Globulariaceae	H158
goetzeac	Solanaceae:Goetzeinae	
goodeniac	Goodeniaceae !	C990; M483:A,B
goupiac	Celastraceae:Goupioideae	
greyiac	Melianthaceae:Greyieae	C562; M286:E
griseliniac	Cornaceae:Griselinieae	
grubbiac	Grubbiaceae !	C472
gunnerac	Haloragaceae:Gunneroideae C=Gunneraceae	H161; M363:G-K
gyrostemonac	Gyrostemonaceae	M83:L,M
halophytac	C = Chenopodiaceae: *Halophytum* (not in M)	
haloragac	Haloragaceae:Haloragoideae C=Haloragaceae	H162, 163; M363:A-E
hanguanoid	Liliaceae: *Hanguana* C=Hanguanaceae	
heliconiac	Musaceae:Heliconieae C= Heliconiaceae	Z328
helwingiac	Cornaceae:Helwingieae	
hemerocall	Liliaceae: *Hemerocallis*	Z278
henriqueziac	Henriqueziaceae	
herrerioid	Liliaceae:Herrerioideae	
himantandrac	Himantandraceae !	
hippocastanac	Hippocastanaceae !	C799; H294:2,3; M284; Z157
hippocrateac	Hippocrateaceae !	C715; H93:3; M295
hippuridac	Hippuridaceae !	C931
hoplestigmatac	Hoplestigmataceae !	
hosta	Liliaceae: *Hosta*	
huac	Styracaceae: *Hua* C=Huaceae	
humiriac	Linaceae:Humirioideae C=Humiriaceae	H169
hyacinthoid	Liliaceae:Scilloideae	M516:B, 518:B
hydatell	Centrolepidaceae:Trithurieae	
hydnorac	Hydnoraceae	M195
hydroleoid	Hydrophyllaceae:Hydroleeae	H171; M430:F,G
hydrophyll	Hydrophyllaceae – Hydroleeae	C907; H172; M430:A-E
hydrostachyac	Hydrostachyaceae !	M243
hymenocardiac	C=Euphorbiaceae: *Hymenocardia* (not in M)	
hypoxidoid	Hypoxidaceae	Correll & Correll 1982, p. 303
hypseocharitac	Oxalidaceae: *Hypseocharis*	M248:G

Appendix C. Continued.

Boundary Group Name	Formal Taxon included	Illustrations
icacinac	Icacinaceae !	H173, 192; M298
idesioid	Flacourtiaceae: *Idesia*	H150:1
illiciac	Illiciaceae !	C97; H174; M119; Z28
irvingioid	Simaroubaceae:Irvingioideae	
iteoid	Saxifragaceae:Iteoideae	H174; Z188
joinvilleac	Flagellariaceae: *Joinvillea* C=Joinvilleaceae	
juglandac	Juglandaceae !	C211; H176; M41; Z173
julianiac	Julianiaceae !	M288
kirkiac	Simaroubaceae:Kirkioideae	
koeberlinioid	Capparaceaae:Koeberlinieae	
krameriac	Krameriaceae !	H178
lacistematac	Flacourtiaceae:Lacistemeae C=Lacistemataceae	
lactoridac	Lactoridaceae !	
lardizabalac	Lardizabalaceae !	C132; H182; M140
lecythidac	Lecythidaceae !	C363; H184; M354
leeac	Leeaceae !	
leitneriac	Leitneriaceae !	M44
lemnac	Lemnaceae !	M597
lennoac	Lennoaceae !	Lawrence 1951, p. 681
lepidobotryac	Oxalidaceae: *Lepidobotrys*	M248:F
lepuropetaloid	Saxifragaceae:Lepuropetaloideae	
limnanthac	Limnanthaceae !	Lawrence 1951, p. 572
lissocarp	Lissocarpaceae !	
lobeliac	Campanulaceae:Lobelioideae	C984; H83:3; M480:H,I; Z213:3
lophiocarp	Phytolaccaceae:Microteoideae p.p.	
lophopyxidac	Celastraceae: *Lophopyxis*	
lowiac	Lowiaceae !	
malesharbiac	Malesharbiaceae !	
marcgraviac	Marcgraviaceae !	H202, 203; M169
martynioid	Martyniaceae	H203, 204
medusagynac	Medusagynaceae !	
medusandrac	Medusandraceae !	H205; M75
melanophyll	Cornaceae: *Melanophylla*	
melianth	Melianthaceae: Meliantheae	C793; H209; M286:A-D
memecylac	Melastomataceae:Memecyloideae	
mendonciac	Acanthaceae:Mendoncioideae	
menyanth	Menyanthaceae !	C901; H212, 213
microteoid	Phytolaccaceae:Microteoideae p.p.	M83:I-K

Appendix C. Continued.

Boundary Group Name	Formal Taxon included	Illustrations
mimuloid	Scrophulariaceae:Gratioleae	M449:B, 450:B
mitrastemonac	Rafflesiaceae:Mitrastemoneae C=Mitrastemonaceae	
molluge	Molluginaceae – Gisekieae	C271; M86:N
monotropac	Pyrolaceae:Monotropoideae C=Monotropaceae	C486; H142:16,17; M383:G-L; Z79:3
montiniac	Saxifragaceae:Montinioideae	
muntingiac	Elaeocarpaceae: *Muntingia*	M305:A,B
myoporac	Myoporaceae !	C956; H221
myricad	Myricaceae !	C216; H222; M40; Z175
myrothamnac	Myrothamnaceae !	
myrsinac	Myrsinaceae – Aegiceratoideae !	C515; H224, 225; M390:D,E; Z84
najadac	Najadaceae !	M510:H-N
nelsoniac	Acanthaceae:Nelsonioideae	
nelumbonac	Nymphaeaceae:Nelumbonoideae C=Nelumbonaceae	C108; Z52
nepenthac	Nepenthaceae !	C373; H227; M177
neurad	Neuradaceae !	
nitrariac	Zygophyllaceae:Nitrarioideae	M251:E
nolanac	Nolanaceae !	Lawrence 1951, p. 692
nolinoid	Agavaceae:Nolineae	
nuphar	Nymphaeaceae: *Nuphar*	M144:F-I; Z51:1
nyctanthac	Verbenaceae:Nyctanthoideae	
nyssac	Nyssaceae	C666; Z192
ochnac	Ochnaceae: Ochneae	C312; H232; M162:A-D
oliniac	Oliniaceae !	
oncoboid	Flacourtiaceae:Oncobeae	H149
oncothecad	C=Oncothecaceae (not in M)	
oxalidac	Oxalidaceae – (*Hypseocharis* & *Lepidobotrys*)	H238, 239; M248:A-E
paeoniac	Paeoniaceae !	C300; H240; M159
pagameoid	Rubiaceae: *Gaertnera* + *Pagamea*	
pandac	Pandaceae !	
pangioid	Flacourtiaceae:Pangieae	M324:E-G
paracryphiac	C=Paracryphiaceae (not in M)	
parnassioid	Saxifragaceae:Parnassioideae	H243; M202:D,K
paropsioid	Flacourtiaceae:Paropsieae	M324:H
paulowniac	Bignoniaceae: *Paulownia*	
pedalioid	Pedaliaceae	M195
pellicier	Theaceae:Pellicieroideae C=Pellicieraceae	

Appendix C. Continued.

Boundary Group Name	Formal Taxon included	Illustrations
penaeac	Penaeaceae !	H246, 247
pentaphragmatac	Pentaphragmataceae !	H249
pentaphylacad	Pentaphylacaceae !	
penthoroid	Saxifragaceae:Penthoroideae	
peridiscad	Peridiscaceae !	
petiverioid	Phytolaccaceae:Rivineae	M83:H; Z62:2
petrosavioid	Liliaceae:Petrosavieae	
phellinac	Aquifoliaceae:Phellineae	
philesioid	Liliaceae:Luzuriagoideae	H390
philydrac	Philydraceae	M540
phormioid	Liliaceae:Dianelleae + *Phormium*	
phrymac	Phrymaceae	Lawrence 1951, p. 710
phyllanthac	Euphorbiaceae:Phyllanthoideae – (*Drypetes* & *Uapaca*)	H251; M256:I-L
phyllonomac	Saxifragaceae:Phyllonomoideae	
physenac	*Physena* (not in M or C)	
picramnioid	Simaroubaceae:Picramnioideae	Correll & Correll 1982, p. 740
picrodendrac	Picrodendraceae	Correll & Correll 1982, p. 411
pittosporac	Pittosporaceae !	C552; H256
plagiopter	C=Flacourtiaceae: *Plagiopteron* (not in M)	
plantage	Plantaginaceae !	C936; M472; Z255
platanac	Platanaceae !	C171; M195; Z168
plocosperm	C = Apocynaceae: *Plocosperma* (not in M)	
plumbage	Plumbaginales !	C283; H258; M395
podophyll	Berberidaceae:Podophylloideae	M138:A,B
podostemonac	Podostemonaceae !	H259; M244
polygalac	Polygalaceae !	C776; H262; M275; Z144
polygonac	Polygonales !	C278; H264; M76; Z87
polypremum	C=Buddlejaceae: *Polypremum* (not in M)	Correll & Correll 1982, p. 1115
potalioid	Loganiaceae:Potalieae	M407:M,N
prockioid	Flacourtiaceae: *Prockia*	M324:I
ptaeroxylac	Meliaceae:Ptaeroxyleae	M270:D
pterostemonac	Saxifragaceae:Pterostemonoideae	
punicad	Punicaceae !	C644; M353
putranjivac	Euphorbiaceae: *Drypetes*	Correll & Correll 1982, pp. 796, 797
pyrolac	Pyrolaceae:Pyroloideae C=Pyrolaceae	C484; H142:13-15; M383:A-F
quiinac	Quiinaceae !	
rapateac	Rapateaceae	H398; M554:F-L
restionac	Restionaceae – Anarthrieae	H399; M558:A-E

Appendix C. Continued.

Boundary Group Name	Formal Taxon included	Illustrations
retziac	C=Retziaceae (*Retzia* not in M)	
rhabdodendrac	Rutaceae:Rhabdodendroideae	
rhinanthoid	Scrophulariaceae:Rhinanthoideae	M451:E,K; Z251:5
rhizophorac	Rhizophoraceae – Anisophylleeae	C656; H279; M358; Z135
rhodoleiac	Hamamelidaceae:Rhodoleioideae	H164:3
rhoipteleac	Rhoipteleaceae !	
ribesioid	Saxifragaceae:Ribesioideae	M202:I
roridulac	Roridulaceae	
sabiac	Sabiaceae	M285
saccifoliac	C=Saccifoliaceae (*Saccifolium* not in M)	C874
salvadorac	Salvadoraceae !	
sansevierioid	Agavaceae:Dracaeneae p.p.	M526:C,D; Z284:1
sarcobatac	Chenopodiaceae:Sarcobateae	
sarcolaenac	Sarcolaenaceae !	
sarcosperm	Sarcospermataceae	
sargentodoxac	Sargentodoxaceae !	H297
sauvagesiac	Ochnaceae - Ochneae	M162:E-O
scheuchzeriac	Scheuchzeriaceae	M504:D
schisandrac	Schisandraceae !	M118
schlegeliac	Bignoniaceae: *Schlegelia*	
scrophularioid	Scrophulariaceae:Scrophularieae + (Collinsieae & Manuleeae)	C952; H302:7; M450:C; Z251:4
scyphostegiac	Scyphostegiaceae !	
scytopetalac	Scytopetalaceae !	
selage	Scrophulariaceae:Selagineae	M449:E, 450:L
simarouboid	Simaroubaceae:Simarouboideae + Alvaradoideae	C810; H304; M267
simmondsiac	Buxaceae:Simmondsieae C=Simmondsiaceae	C734
sonneratiac	Sonneratiaceae	
sparganiac	Sparganiaceae	C1154; M600
sphaerosepelac	Sphaerosepelaceae !	
sphenocleac	Sphenocleaceae !	
sphenostemonac	Aquifoliaceae: *Sphenostemon*	
spigelioid	Loganiaceae:Spigelieae	H195:2; M407:I-K
stachyurac	Stachyuraceae !	C400
stackhousiac	Stackhousiaceae !	
staphyleac	Staphyleaceae !	C790; H310
stegnosperm	Phytolaccaceae:Stegnospermatoideae	M83:F,G
stemonac	Stemonaceae !	

Appendix C. Continued.

Boundary Group Name	Formal Taxon included	Illustrations
stilboid	Verbenaceae:Stilboideae	
strasburger	Strasburgeriaceae	
strelitziac	Musaceae:Strelitzioideae – Heliconieae C=Strelitziaceae	C1171; H402; M608:F,G; Z326
strychnoid	Loganiaceae:Strychneae	H195:1; M407:D-H
stylidiac	Stylidiaceae: Stylidioideae C= Stylidiaceae	M483:F,G
stylobasiac	Chrysobalanaceae: *Stylobasium*	
styloceratac	Buxaceae:Stylocereae	
styracad	Styracaceae !	C502; M401
surianac	Simaroubaceae:Surianeae	C583
symphorematoid	Verbenaceae:Symphorematoideae	
symplocad	Symplocaceae !	C505; M402
taccad	Taccaceae	
tecophilaeac	Haemanthaceae:Conanthereae + Conostylideae p.p.	H403
tepuianth	C=Tepuianthaceae (not in M)	
ternstroemiac	Theaceae:Ternstroemieae	M167:G-K
tetracarpaeac	Saxifragaceae:Tetracarpaeoideae	
tetracentrac	Tetracentraceae !	M128:C,D
tetrachondrac	Labiatae: *Tetrachondra*	
tetramelac	Datiscaceae:Tetrameleae	M338:A
tetrameristac	Theaceae:Tetrameristoideae	
theligonac	Theligonaceae !	
theophrastac	Theophrastaceae !	C513; M390:A,B
thunbergiac	Acanthaceae:Thunbergioideae	H23:2; M457:K
thurniac	Thurniaceae	M544:P-S
thymelaeac	Thymelaeaceae !	C635; H320, 321; M319
tofieldioid	Liliaceae:Tofieldioideae	M516:C
toricelliac	Cornaceae:Toricellieae	
trapac	Trapaceae !	M348
tremandrac	Tremandraceae !	
tribelac	Saxifragaceae:Tribeliseae	
trichostephanoid	Flacourtiaceae:Trichostephaneae	
trigoniac	Trigoniaceae !	M274:A,B
trimeniac	Trimeniaceae !	C65
triuridale	Triuridales	C1075; M513
trochodendrac	Trochodendraceae	C161; M128:A,B
tropaeolac	Tropaeolaceae	C833; H325; M250
uapacad	Euphorbiaceae: *Uapaca*	

Appendix C. Continued.

Boundary Group Name	Formal Taxon included	Illustrations
uvularioid	Liliaceae:Uvularieae	
vahlioid	Saxifragaceae:Vahlioideae	
velloziac	Velloziaceae	M532
verbascoid	Scrophulariaceae:Verbasceae + (Leucophylleae & Aptosimeae)	M449:A, 450A,D; Z251:1
veronicoid	Scrophulariaceae:Veroniceae	M449:D, 450:I
viticoid	Verbenaceae:Viticoideae	H181; M436:B-D,G,H,K; Z267
vivianiac	Geraniaceae:Vivianieae	
vochysiac	Vochysiaceae !	H336; M274:C-E
xanthorrhoeoid	Xanthorrhoeaceae – Dasypogoneae	
zelkova	Ulmaceae: *Zelkova*	M53:G
zygophyll	Zygophyllaceae – (Balanitoideae & Nitrarioideae)	C818; M251:A-D,F-I