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A graphic representation of Hutchinson's phylogenetic system

by

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As LAWRENCE (10) so aptly points out, HUTCHINSON'S phylogenetic classification "...has been a greater stimulant to phyletic thinking during the past decade or two than any other similar contribution." In one major work (6) and parts of two others (7, 8), HUTCHISON has presented his viewpoints and his systematic arrangement of the Angiosperms, revising from one to another publication his interpretation and treatment of individual orders or families, but maintaining the principal tenets of his original statement, namely, the early derivation of separate, predominantly woody and predominantly herbaceous lines from a hypothetical proangiosperm stock, and of the monocots from the herbaceous dicot branch through the Ranales-Alismatales-Butomales series; the primitiveness of the Ranalean flower type; and the polyphylectic development from this early condition towards syncarpy, sympetaly, apetaly, zygomorphy, epigyny, etc.

In HUTCHINSON'S publications, as well as in BARKLEY'S (1) and LAWRENCE'S (10, p. 137), diagrams are presented showing as linear sequences his concept of the relationships of the various orders or families. HUTCHINSON (7, p. 649) stressed the fact that such a diagram "... is not intended to convey the idea that families are derived from each other as they exist at the present time, but that one or more have been derived from the same basal stock as the one lower down in the family 'tree'." The possibility of confusion of these two completely different concepts has been pointed out by BARKLEY (op. cit) and by RODRÍGUEZ (11), the latter with reference to BESSEY'S (2) familiar "cactus plant" illustration

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of his own phylogenetic treatment of the Angiosperms. Both authors pointed out that a phylogenetic diagram should be thought of as a cross-section of the "family tree", made at a particular moment in time —i.e., the present— rather than as a "family tree" in itself.

Other graphic arrangements are in frequent use (especially in reference to the Besseyan system), drawn after the fashion developed by CLEMENTS & SHOWALTER (4) —cf. HOLMAN & ROBBINS (5), pp. 577 and 579, and LAWRENCE (op. cit.), p. 126— in which similar linear sequences are drawn across other lines indicating the boundary between two opposite conditions, as hypogyny /epigyny etc., one of which is considered more primitive than the other. Such boundary lines, of necessity, course more or less irregularly over the page. While this type of diagram is completely satisfactory for a *natural* system, for a phylogenetic system it has the same drawback as the "cactus plant" type, namely, that the impression is given of *descent* where a *common origin* is meant; besides, phyletic lines are drawn to fit their length into the page, and it is the boundary lines which are made to adapt to them. In the case of HUTCHINSON'S system, this type of diagram is completely satisfactory for a *natural* system, for a phylocation of the flower, such as zygomorphy, epigyny, etc., are reached by a large number of independent phyletic lines, and not always in the same sequence.

In the present diagram (fig. 1) the author again tries to follow LAM'S (9) dictum that every feature of a phylogenetic diagram should be meaningful. The drawing should again be thought of as a cross-section of the true "family tree" of the angiosperms built up through the ages. The Hutchinsonian phyletic lines are shown as radiating outwards from the axis of the tree, i.e., the point where all primitive features are indicated. The two major cleavages of the system — the separation of the "woody" and "herbaceous" branches of the dicotyledons, and of the monocotyledons from the herbaceous branch — are shown as straight lines cutting across the diagram; while the most easily recognizable and phylogenetically significant transitions in flower structure, apocarpy/syncarpy, apopetly /sympetaly, actinomorphy/zygomorphy, and hypogyny/epigyny, are shown as circular lines centering on the axis of the family tree (fig. 2). When HUTCHINSON'S successions of orders are plotted on this frame, it becomes apparent, as mentioned above, that the various advanced features have not been acquired in the same order by the different lineages, and that some interweaving of the boundary lines is unavoidable. In general, the placing of syncarpy as the first barrier crossed, and of sympetaly as the second, is justifiable since only a few groups such as the sympetalous Crassulaceæ have achieved sympetaly before syncarpy. Since the other two features have, in HUTCHINSON'S concept, less diagnostic value for the definition of orders, they are made to interweave with the first two more freely.

Groups having a monocarpellate gynoecium, which is considered an advance over, and a derivative by reduction from an apocarpic, multi-pistillate gynoecium, are placed in the same area as the syncarpous groups, and distinguished from them by means of red hatching. Likewise, apetalous groups must be included within the boundary marking the transition to sympetaly, and are distinguished from dialipetalous groups by blue stippling.

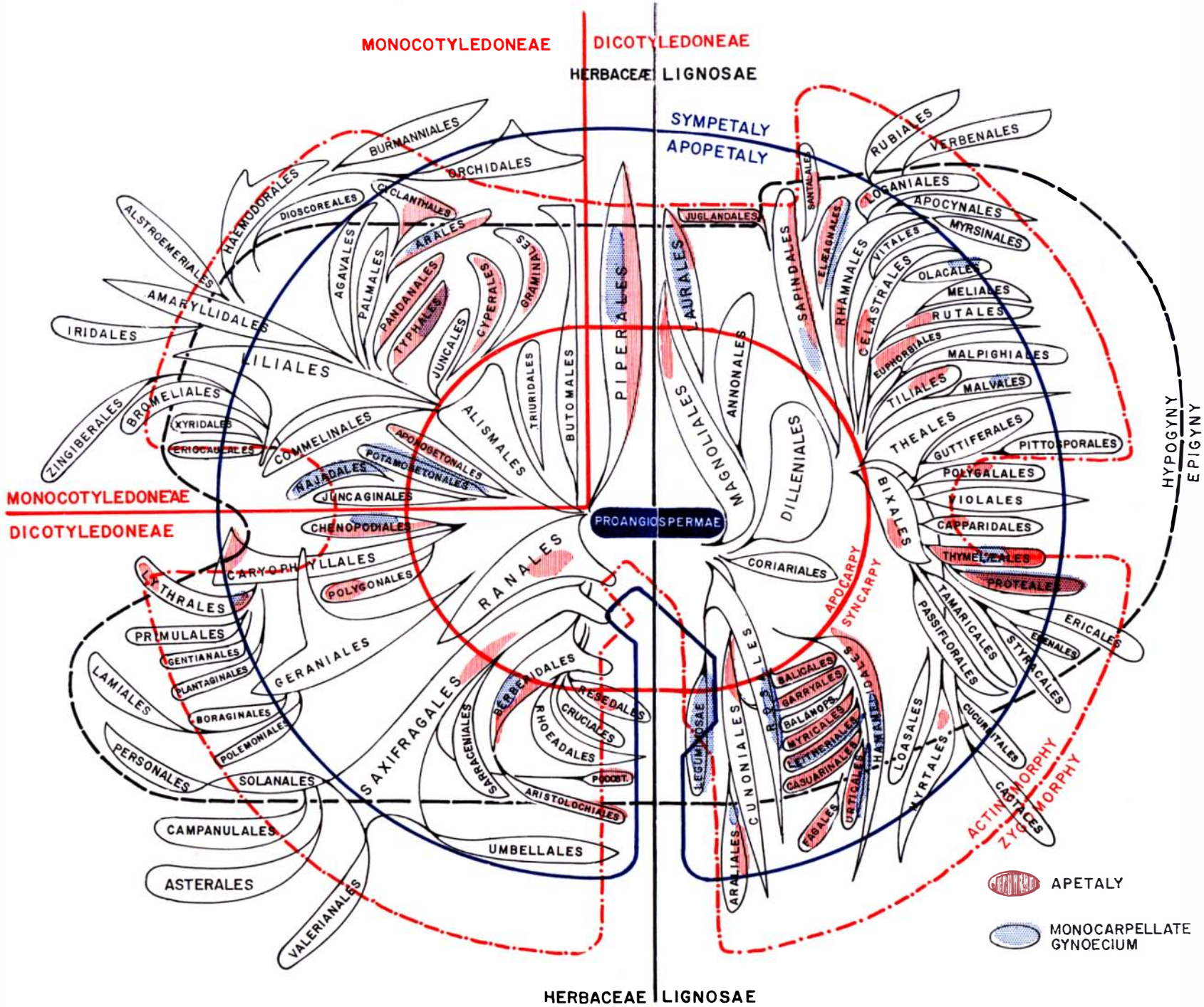
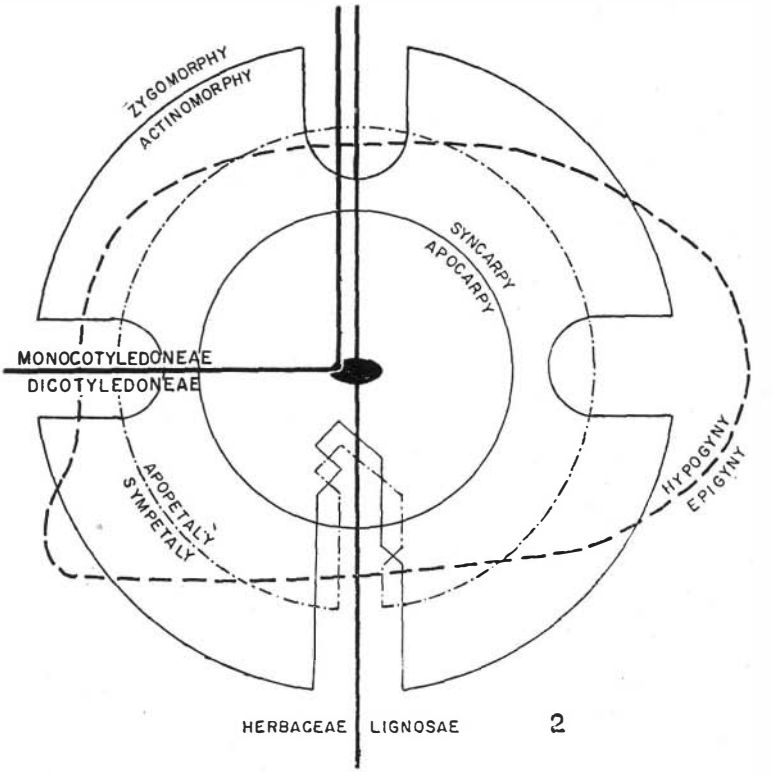


Fig. I. A graphic representation of Hutchinson's phylogenetic system of the Angiosperms.



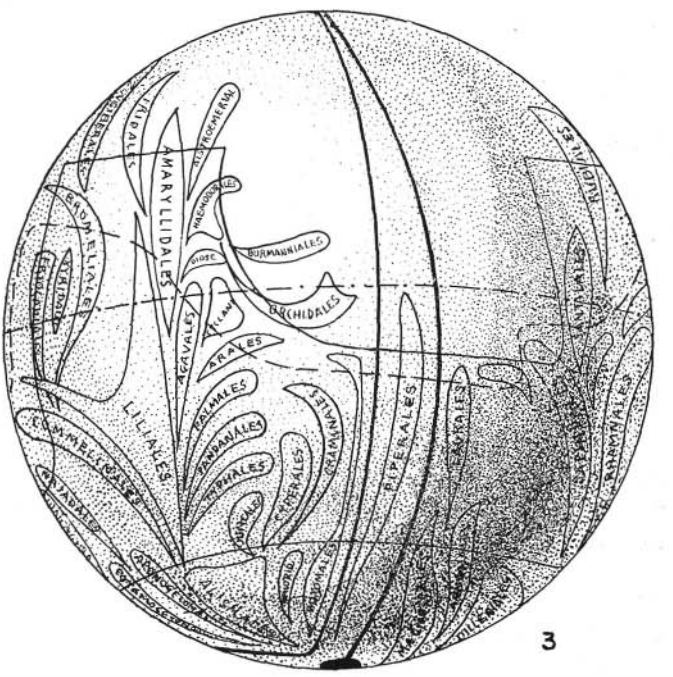


Fig. 2: The frame upon which Hutchinson's orders are plotted in Fig. 1.
Fig. 3: The diagram shown in Fig. 1 drawn on the surface of a sphere.

The area covered by the branches or figures representing the orders is determined mostly by the extremes of variation occurring within each order, i.e, by the boundary lines it must be made to cross. No attempt is made to indicate the number of genera or species by the relative size of the figures. The shape of the figures has been drawn to indicate the postulated origin of each group, the conditions prevailing within it, and the trend or trends it exhibits, as in the case of the Geraniales and Liliales which, showing a general trend from apocarpy to prevailing syncarpy, and in some cases into sympetaly, comprise also some families in which zygomorphy has been attained before sympetaly.

As far as possible, resemblances or affinities other than those indicated by the dividing lines and the postulated phylogenetic sequences have been shown by the proximity or the relative position of the groups. Thus the Piperales, of herbaceous dicotyledon ancestry, are made to lie near Magnoliales and Laurales on one side, and near the Monocot boundary on the other — to recall the peculiarities of vascular anatomy stressed by HUTCHINSON; while the morphologically similar Araliales and Umbellales, given a different phylogeny by him, are made to approach each other from different sides.

However, it will be observed that on this frame, some groups morphologically similar but considered by HUTCHINSON to belong to separate lines of relationship, as Personales and Bignoniales, Rubiales and Valerianales, Verbenales and Labiales, appear to evolve in opposite directions, although crossing the same boundary lines in doing so. A similar distortion is familiar in the polar projection maps in frequent use nowadays. If the analogy is followed one step further, and the diagram imagined drawn on the surface of a sphere (fig. 3), the most advanced groups would appear to converge near the pole opposite to that occupied by the "proangiosperms", illustrating HUTCHINSON's concept of the polyphyletic development of similar characteristics. Even as the flat diagram is thought of as a 2-dimensional projection or cross-section of the "family tree" of the Angiosperms, such a spherical diagram would still represent a projection or cross-section, a 3-dimensional one, of a family tree — perhaps one built up in a hyperspatial field in the sense popularized by BRAGDON (3).

Additional characteristics, such as the presence or absence of endosperm or of stipules, total loss of a perianth, the type of nodal structure, etc., could be integrated into the diagram frame either by means of additional lines or as was done with apetaly and the monocarpellate gynoecium. The limitations of size and dimensionality of the printed page render doing so unadvisable for the sake of clarity. In any event, the writer believes this manner of representation of HUTCHINSON'S system to be helpful for teaching purposes, and for the visualization of the system as a whole and of its implications. It also might be used as a tool for analysis and evaluation of the relationships propounded, or of the significance and correlation of other features not included here, in the elucidation of the phylogeny of the flowering plants.

RESUMEN

El autor publica una representación gráfica del sistema filogenético de HUTCHINSON (fig. 1), la que, según advirtieran BARKLEY (1), LAM (9) y RODRÍGUEZ (11), se debe considerar como una proyección o corte transversal del "árbol genealógico" de las angiospermas, y no como un árbol genealógico en sí. Se indican como círculos concéntricos las líneas divisorias entre dos características opuestas, una de las cuales se considera más primitiva que la otra: apocarpia/sincarpia, apopetalia/simpetalia, hipoginia/epiginia, y actinomorfia/zigomorfia. Por haber alcanzado las distintas líneas filéticas postuladas por HUTCHINSON una condición avanzada antes que otras, y en orden diverso, se hace necesario entrecruzar estas líneas en algunos puntos. Las divisiones principales, la de las dicotiledóneas leñosas y herbáceas a partir de "proangiospermas" hipotéticas, y de las monocotiledóneas a partir de la línea herbácea por la serie Ranales-Alismatales-Butomales, se indican por líneas rectas radiales (fig. 2). La presencia de un gineceo monocarpelar se ha indicado con puntuado azul; la condición apétala, por medio de rayado rojo.

Se observa en este diagrama que grupos similares en su morfología, pero colocados por HUTCHINSON en distintas líneas filéticas, como Labiales y Verbenales, Personales y Bignoniales, etc., parecen evolucionar en sentido opuesto, aunque crucen las mismas líneas divisorias al hacerlo. Si se imagina el diagrama trazado sobre la superficie de una esfera, los grupos avanzados que en un plano aparecen divergentes se verían convergir hacia el polo opuesto al ocupado por las proangiospermas, ilustrando así el concepto de HUTCHINSON del desarrollo polifilético de caracteres similares (fig. 3). Tal diagrama esférico continuaría siendo una proyección del verdadero árbol genealógico, que habría que imaginar en un espacio multidimensional.

Este tipo de diagrama facilita la enseñanza y la comprensión de los conceptos de HUTCHINSON, y puede aprovecharse como instrumento de análisis y crítica de los parentescos y derivaciones postuladas, o del valor de características adicionales en la elucidación de la filogénesis de las angiospermas.

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