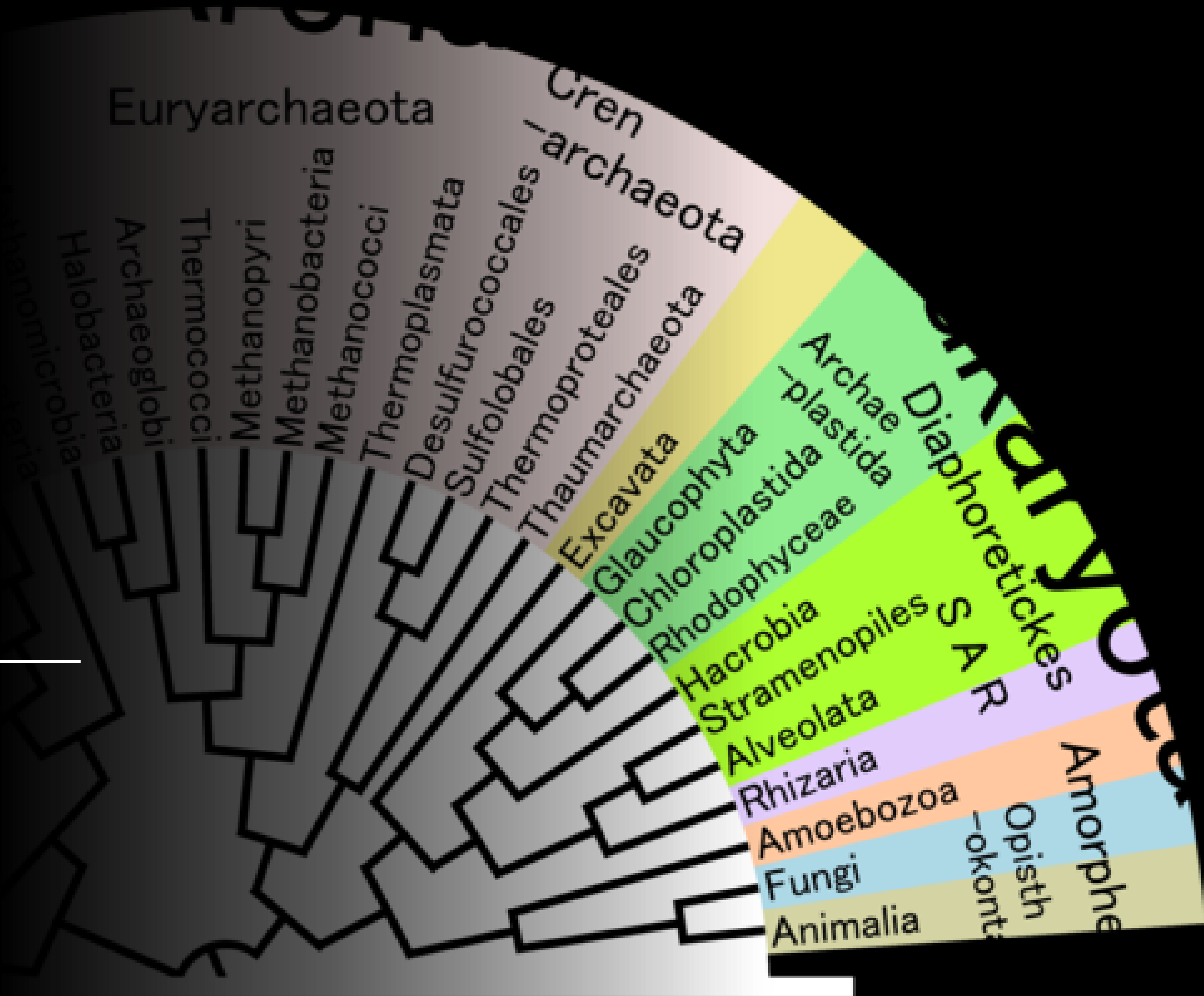
História da Sistemática Filogenética

5920818 - Evolução e Sistemática Biológica

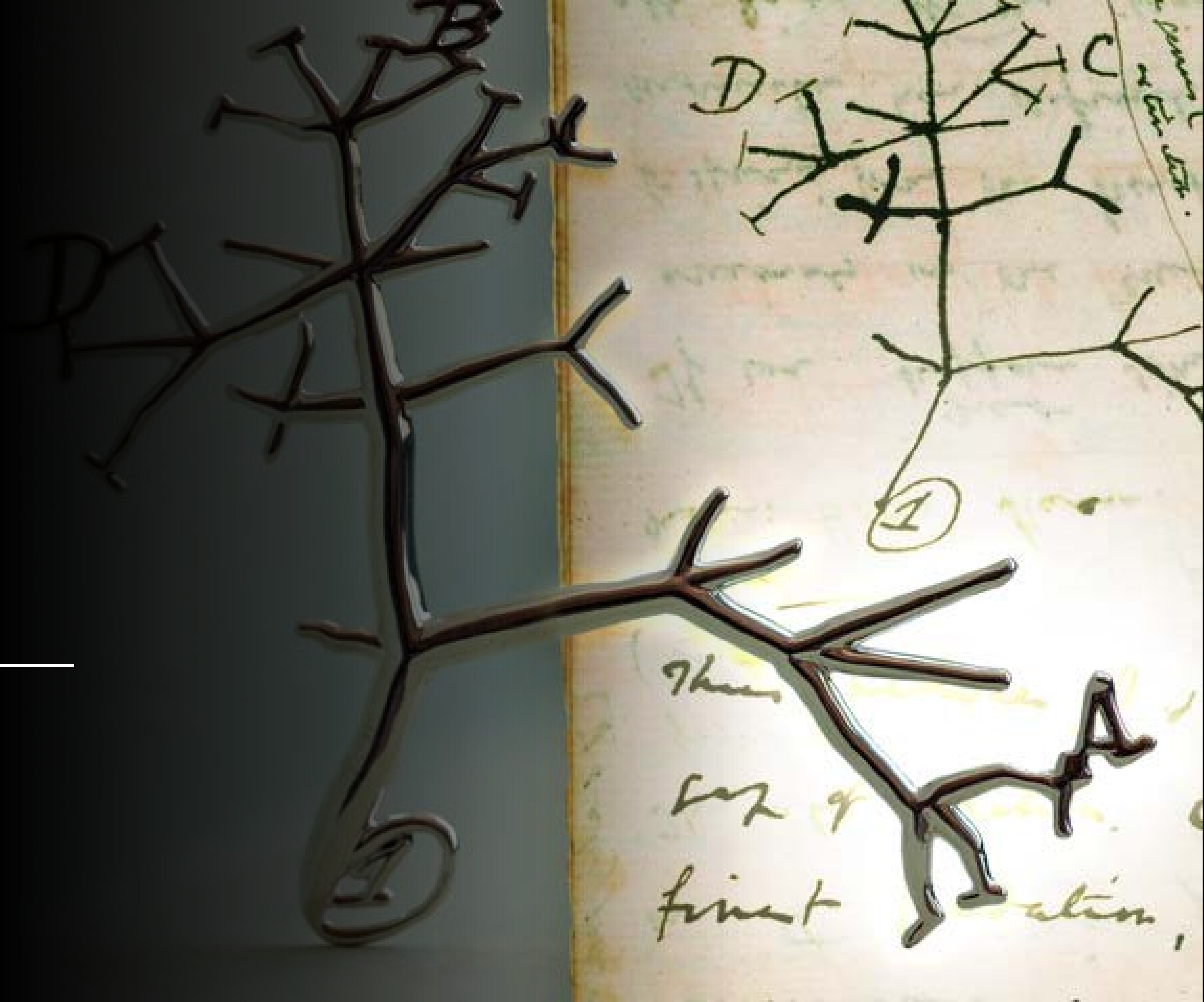
Dept. Biologia – FFCLRP - USP

Flávio A. Bockmann

2023



Contexto histórico



Contexto histórico

Diagramas pré-darwinianos

– *Diagramas expressando relações entre organismos precedem em muito a Teoria Evolutiva*

– *Diferentes* ***ontologias***

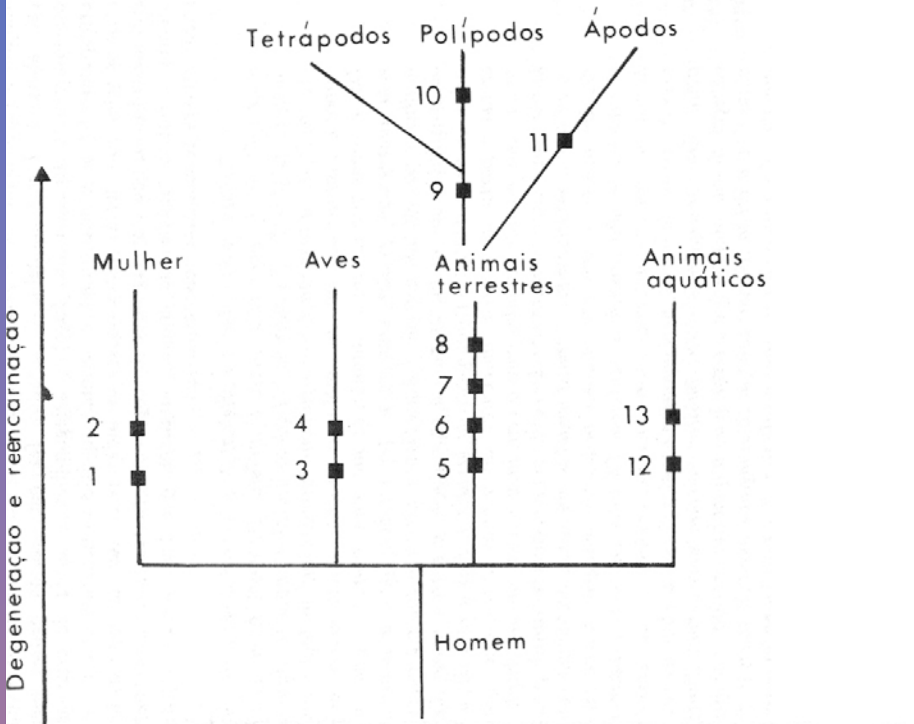


Fig. 4: Dendrograma das diversas classes de animais resultantes do homem por degeneração e reencarnação, com seus respectivos caracteres: 1. Covardes; 2. Vida desregrada; 3. Inocentes, de mente aérea, acreditando poderem ser as coisas apreendidas pelos sentidos; 4. Transformação de pelos em penas; 5. Ausência de conhecimento filosófico; 6. Pernas dianteiras e cabeça dencansando sobre a terra; 7. Modificação da crista da cabeça; 8. Alma esmagada em razão do desuso; 9. Por serem insensíveis, necessitam maior apoio à terra; 10. Aumento do número de pernas por maior insensibilidade; 11. Total insensibilidade – portanto, arrastam-se com o ventre sobre a terra; 12. Alma tornada impura por toda a sorte de transgressões: ao invés do sutil e puro meio aéreo, são arrojados ao fundo lamacento de rios e mares; 13. Desmesurada ignorância.

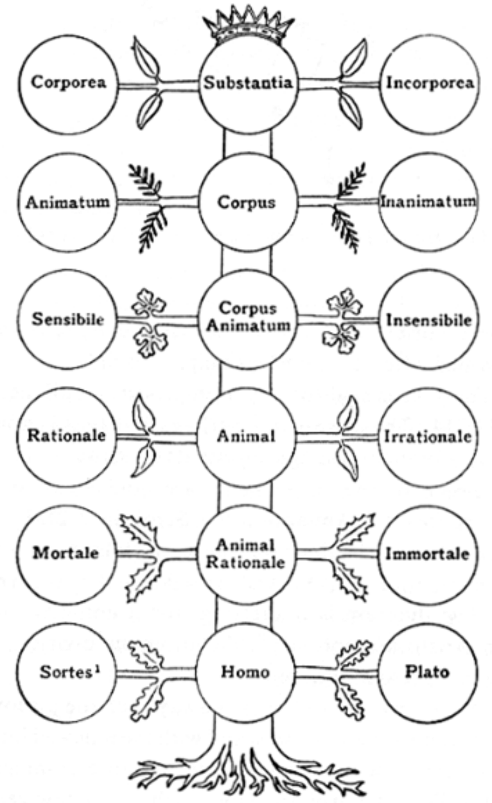


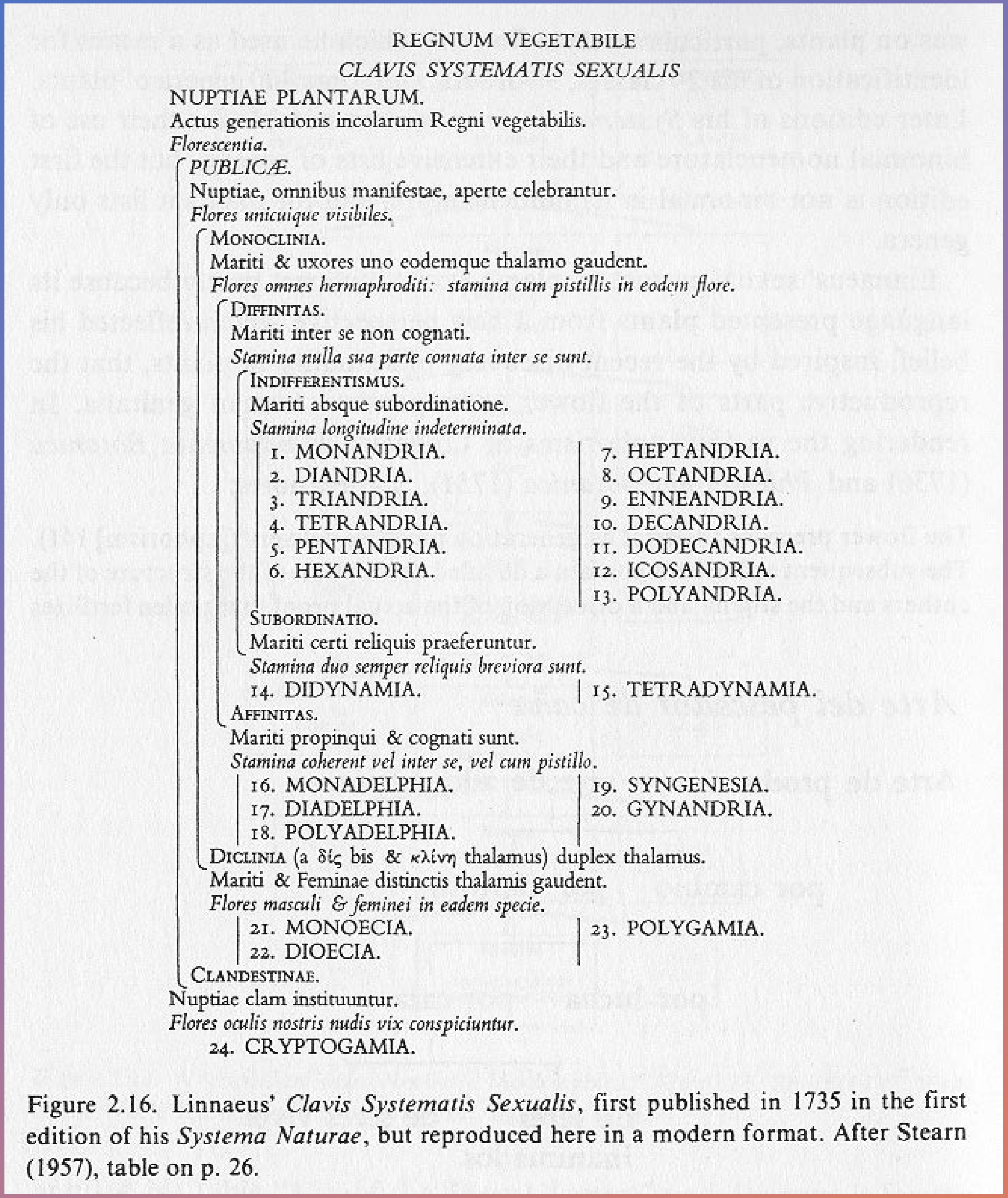
Figure 2.6. The Tree of Porphyry (*Baum des Porphyrius*; *Arbre de Porphyre*; *Scala Ternaria di Porferio*). After Baldwin (1911), figure on p. 714.

- ***Diérese aristotélica*** – divisão lógica

Aristóteles **(384-322 A.C.)**

Contexto histórico

Diagramas pré-darwinianos



REGNUM VEGETABILE

CLAVIS SYSTEMATIS SEXUALIS

NUPTIAE PLANTARUM.
Actus generationis incolarum Regni vegetabilis.
Florescentia.

PUBLICÆ.
Nuptiae, omnibus manifestae, aperte celebrantur.
Flores unicuique visibiles.

MONOCLINIA.
Mariti & uxores uno eodemque thalamo gaudent.
Flores omnes hermaphroditi: stamina cum pistillis in eodem flore.

DIFFINITAS.
Mariti inter se non cognati.
Stamina nulla sua parte connata inter se sunt.

INDIFFERENTISMUS.
Mariti absque subordinatione.
Stamina longitudine indeterminata.

1. MONANDRIA.
2. DIANDRIA.
3. TRIANDRIA.
4. TETRANDRIA.
5. PENTANDRIA.
6. HEXANDRIA.
7. HEPTANDRIA.
8. OCTANDRIA.
9. ENNEANDRIA.
10. DECANDRIA.
11. DODECANDRIA.
12. ICOSANDRIA.
13. POLYANDRIA.

SUBORDINATIO.
Mariti certi reliquis praeferuntur.
Stamina duo semper reliquis breviora sunt.

14. DIDYNAMIA.
15. TETRADYNAMIA.

AFFINITAS.
Mariti propinqui & cognati sunt.
Stamina coherent vel inter se, vel cum pistillo.

16. MONADELPHIA.
17. DIADELPHIA.
18. POLYADELPHIA.
19. SYNGENESIA.
20. GYNANDRIA.

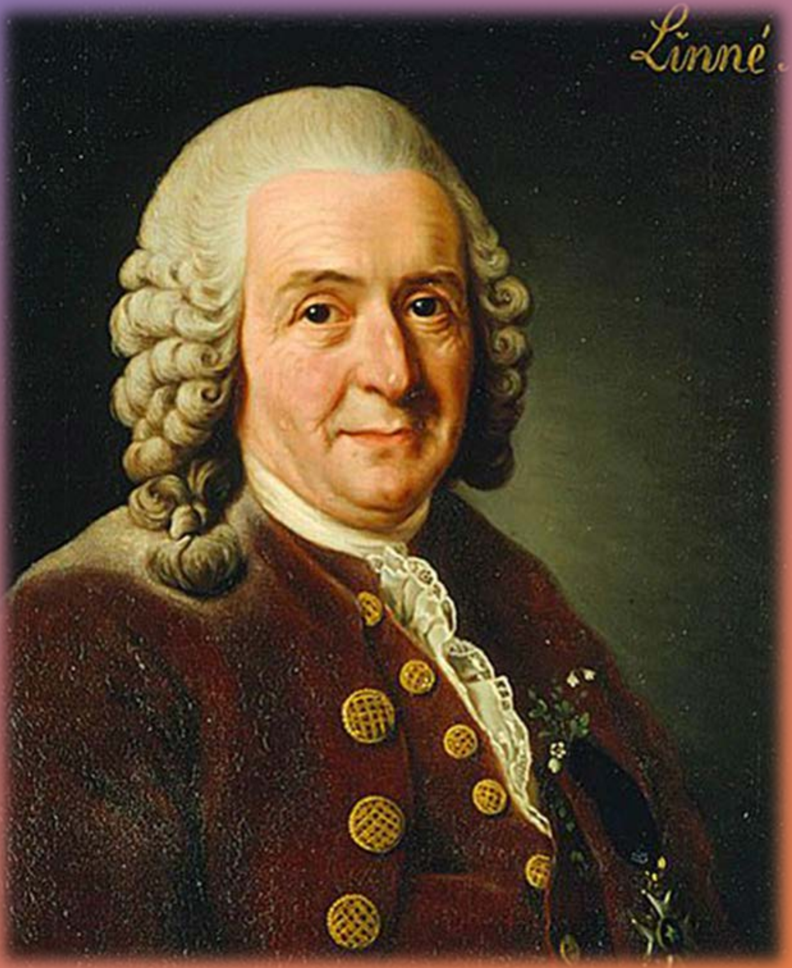
DICLINIA (a δὶς bis & κλίνη thalamus) duplex thalamus.
Mariti & Feminae distinctis thalamis gaudent.
Flores masculi & feminei in eadem specie.

21. MONOECIA.
22. DIOECIA.
23. POLYGAMIA.

CLANDESTINAE.
Nuptiae clam instituuntur.
Flores oculis nostris nudis vix conspiciuntur.

24. CRYPTOGAMIA.

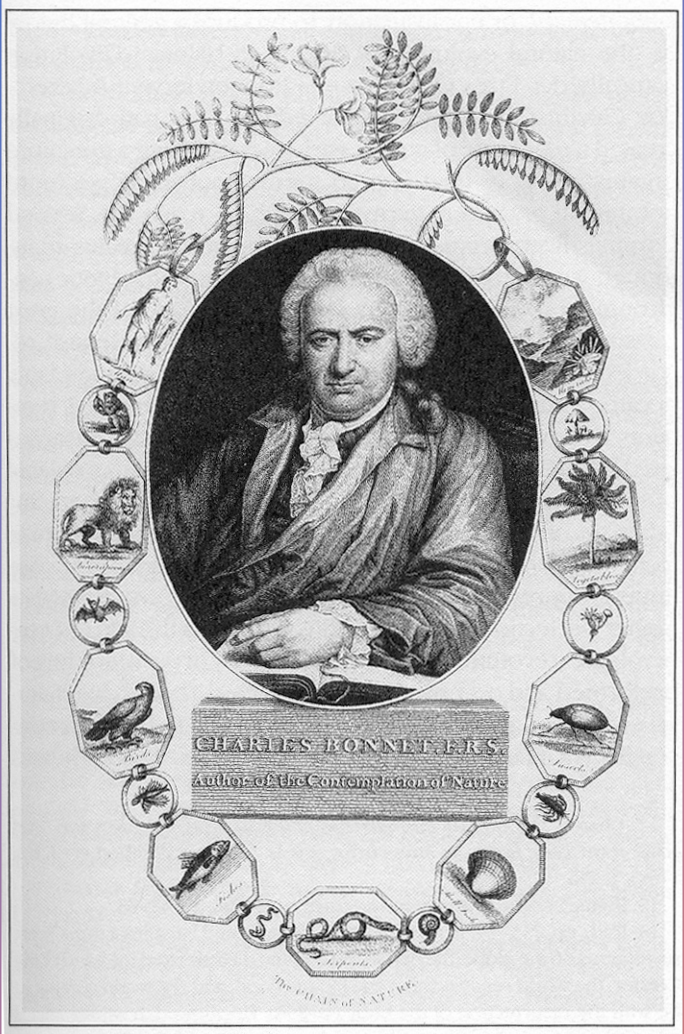
Figure 2.16. Linnaeus' *Clavis Systematis Sexualis*, first published in 1735 in the first edition of his *Systema Naturae*, but reproduced here in a modern format. After Stearn (1957), table on p. 26.

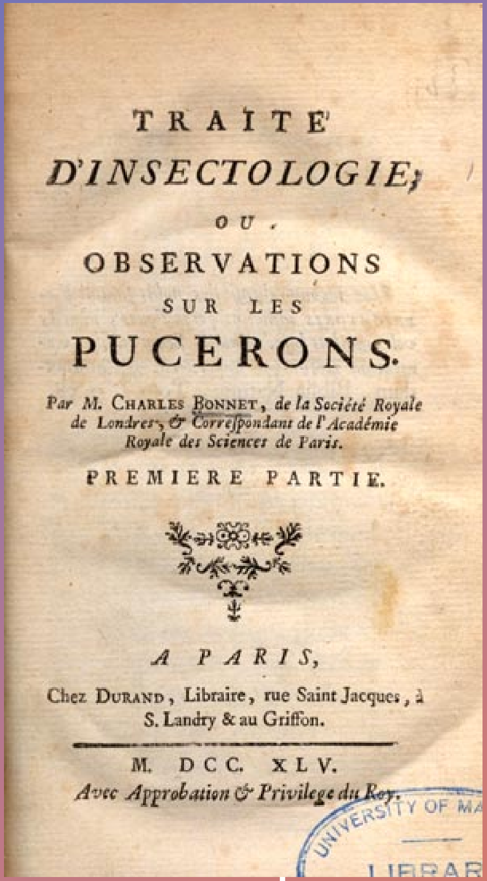


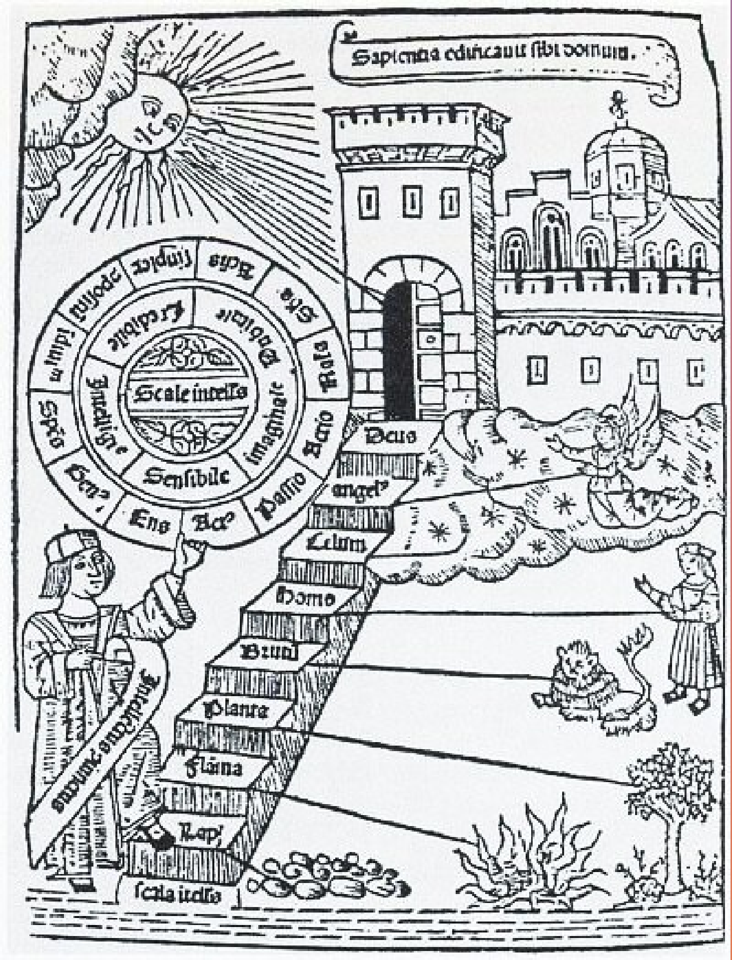
Carolus Linnaeus (1707, Råshult -1778, Uppsala)

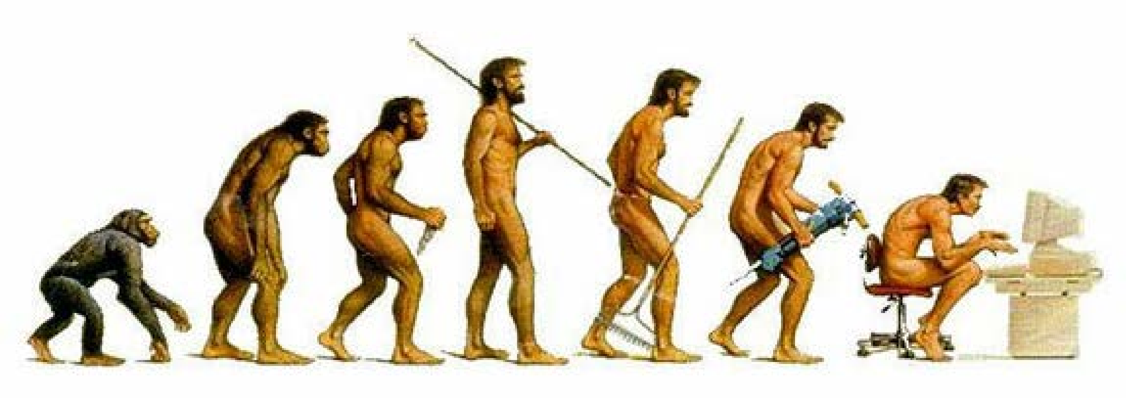
Contexto histórico

Diagramas pré-darwinianos




TRAITÉ
D'INSECTOLOGIE;
OU
OBSERVATIONS
SUR LES
PUCERONS.
Par M. CHARLES BONNET, de la Société Royale de Londres, & Correspondant de l'Académie Royale des Sciences de Paris.
PREMIERE PARTIE.
A PARIS,
Chez DURAND, Libraire, rue Saint Jacques, à S. Landry & au Griffon.
M. DCC. XLV.
Avec Approbation & Privilege du Roy.



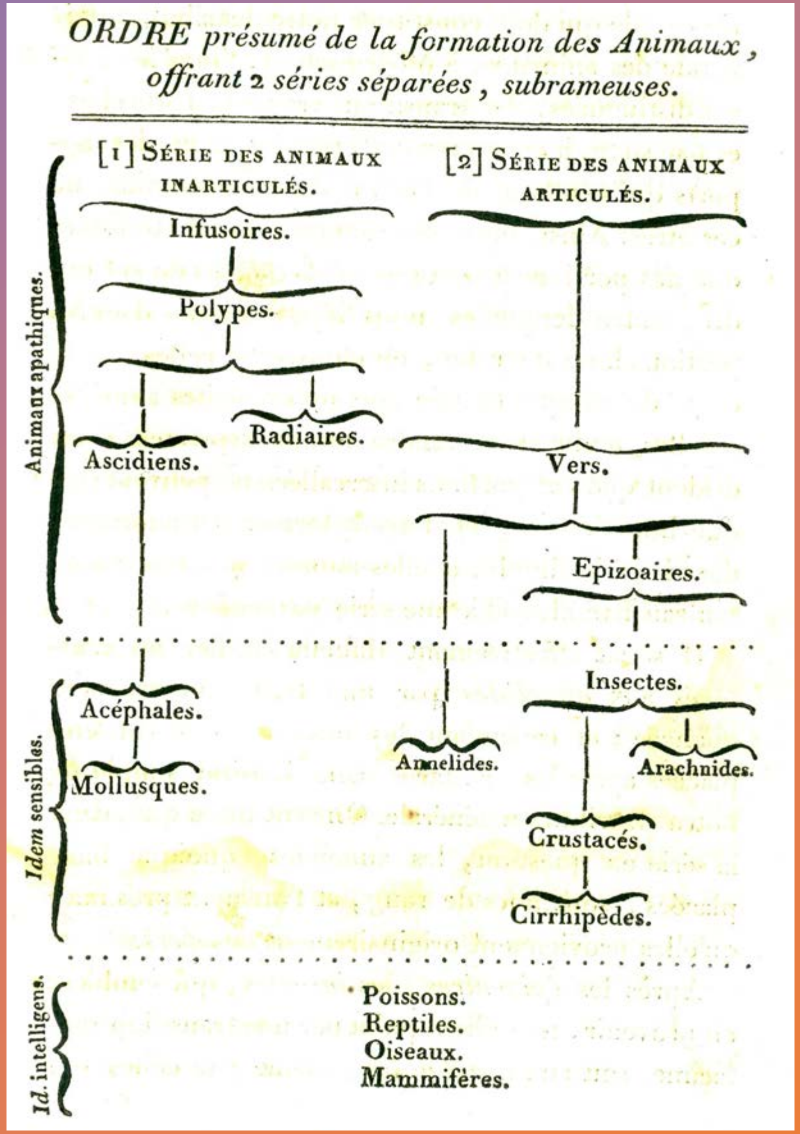


Charles Bonnet (1720, Genebra – 1793, Genthod) – '*Le Grand Échelle des Étres*" => transformação direcionada, programada

Contexto histórico

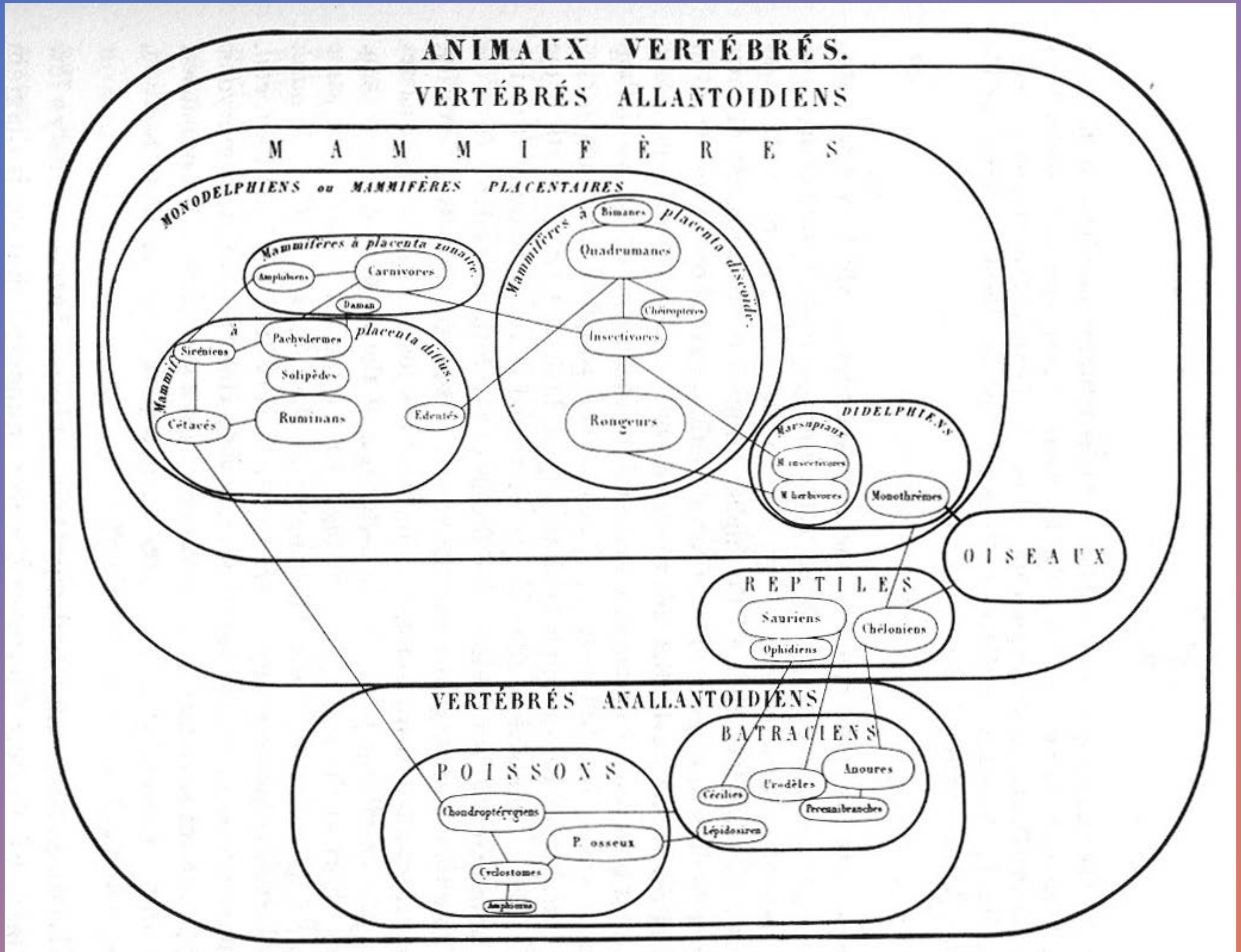
Diagramas pré-darwinianos

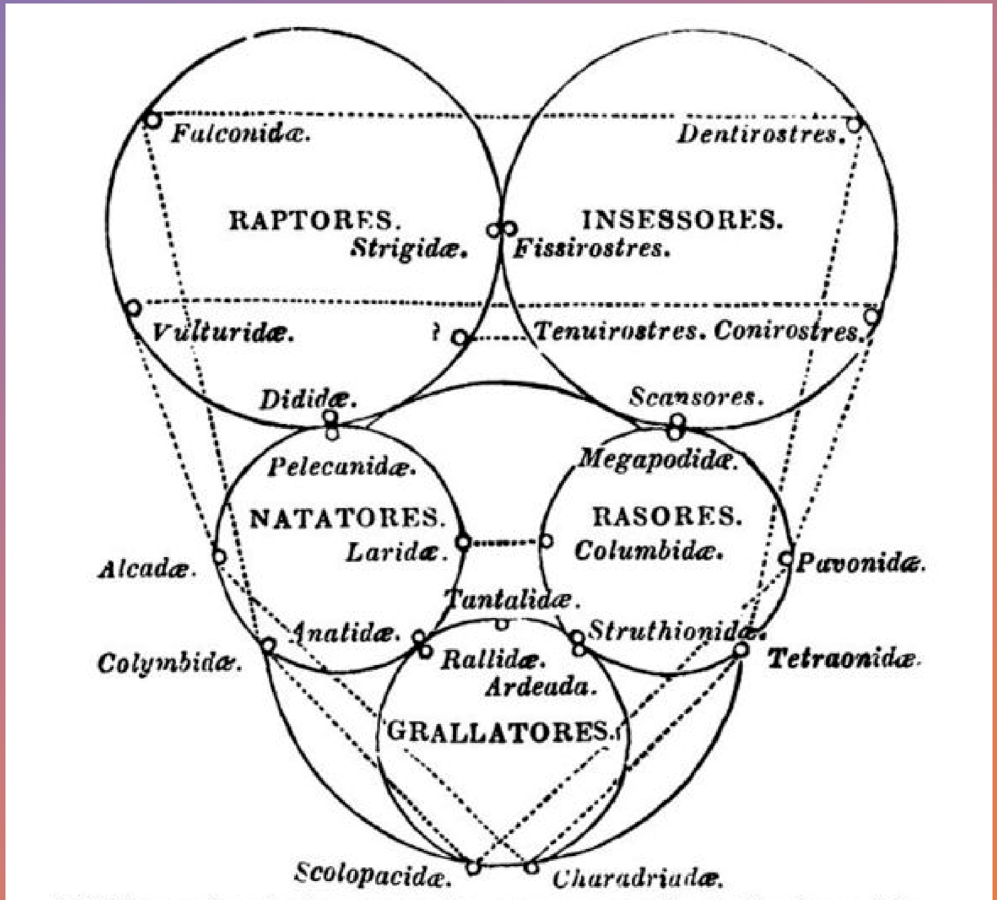
Jean-Baptiste de Lamarck (1744, Bazentin – 1829, Paris) – ‘*Le Grand Échelle des Étres*” => transformação direcionada, programada



Contexto histórico

Diagramas pré-darwinianos





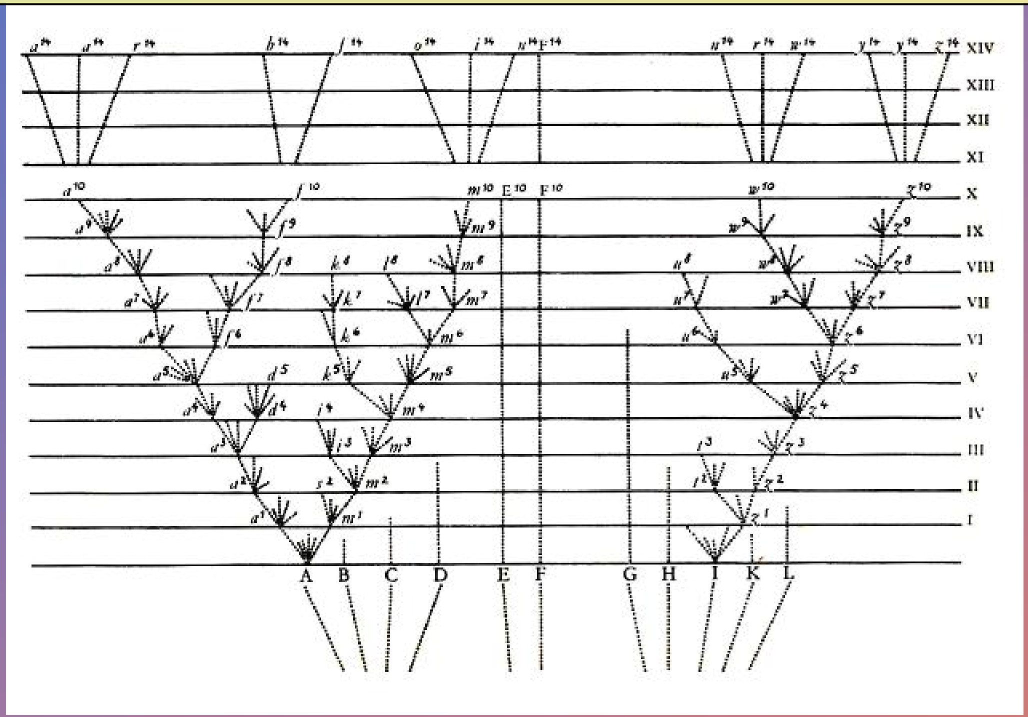
Affinities and analogies among the groups according to Swainson. The circles touch with groups on them having "affinities", but the lines connect groups that showed "analogies".

Afinidades naturais dos animais vertebrados - **M. Milne-Edwards** (1844), Considerations sur quelques principes relatifs à la classification naturelle des animaux. *Ann. Sci. Nat.*, sér. 3, 1: 65-99.

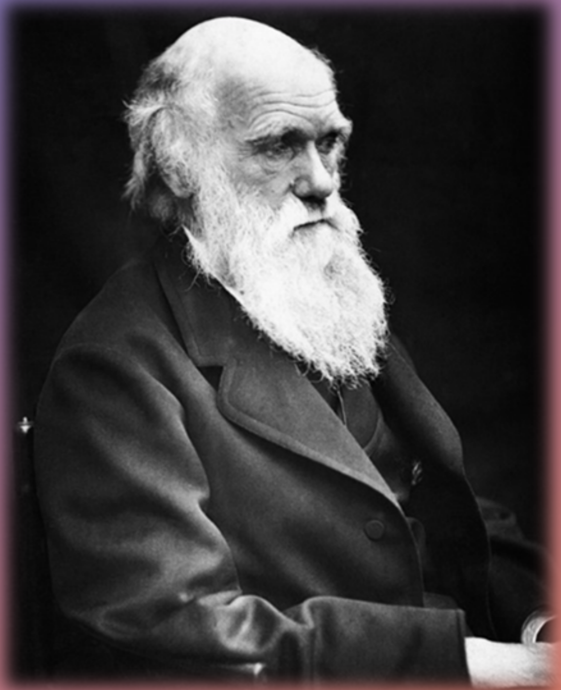
Contexto histórico
Teoria da Evolução

– Espécies mutáveis ao longo tempo, em fluida transformação => evolução é gradual e lenta

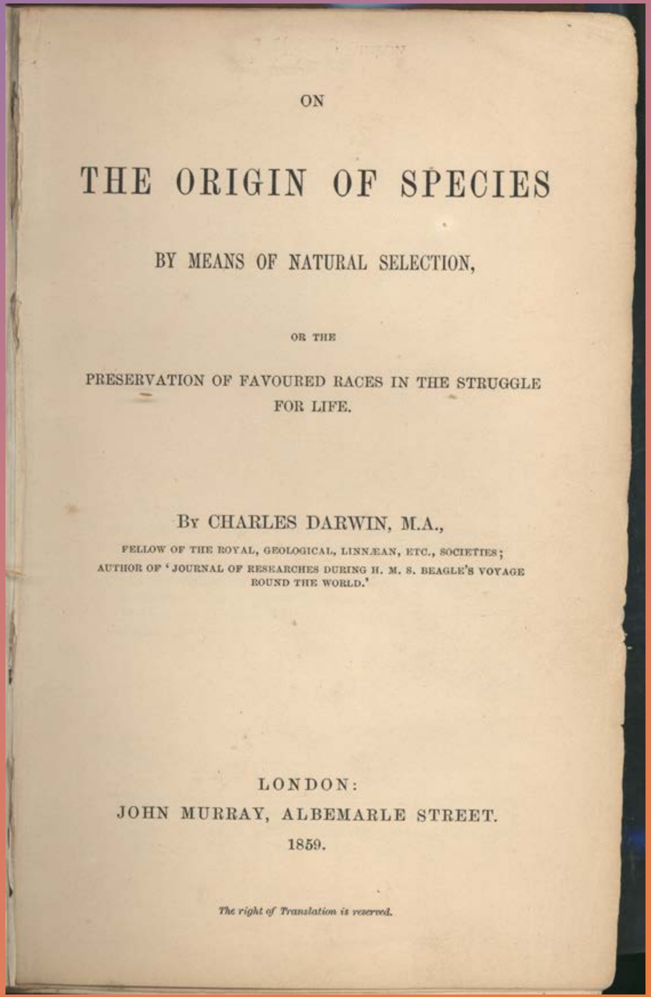
– Diversidade é produto da seleção natural



- Introduziu o eixo do **TEMPO (PROFUNDO)** nos diagramas de relacionamento => **árvores evolutivas**



Charles R. Darwin
(1809, Shrewsbury – 1882, Downe)



ON

THE ORIGIN OF SPECIES

BY MEANS OF NATURAL SELECTION,

OR THE

PRESERVATION OF FAVOURED RACES IN THE STRUGGLE FOR LIFE.

BY CHARLES DARWIN, M.A.,

FELLOW OF THE ROYAL, GEOLOGICAL, LINNÆAN, ETC., SOCIETIES;
AUTHOR OF 'JOURNAL OF RESEARCHES DURING H. M. S. BEAGLE'S VOYAGE ROUND THE WORLD.'

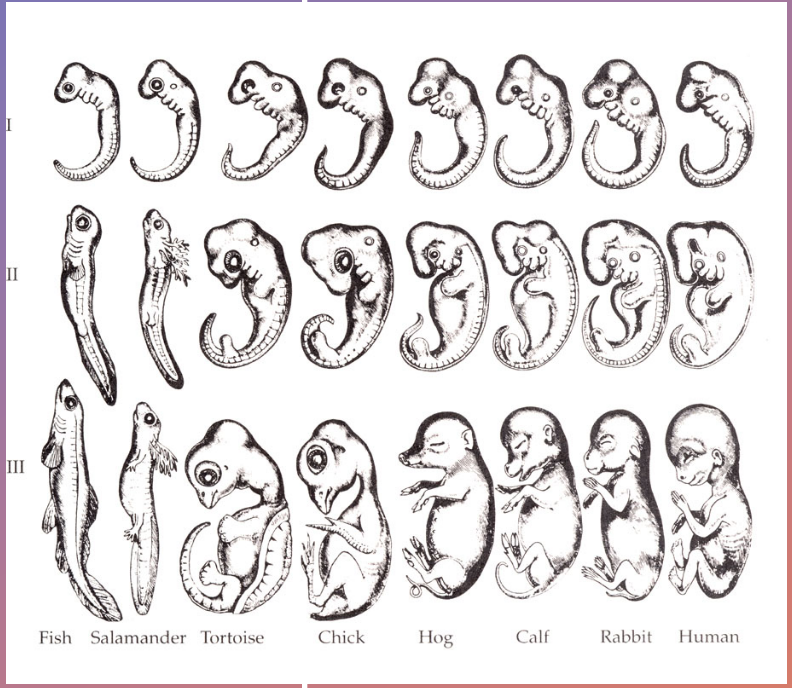
LONDON:
JOHN MURRAY, ALBEMARLE STREET.
1859.

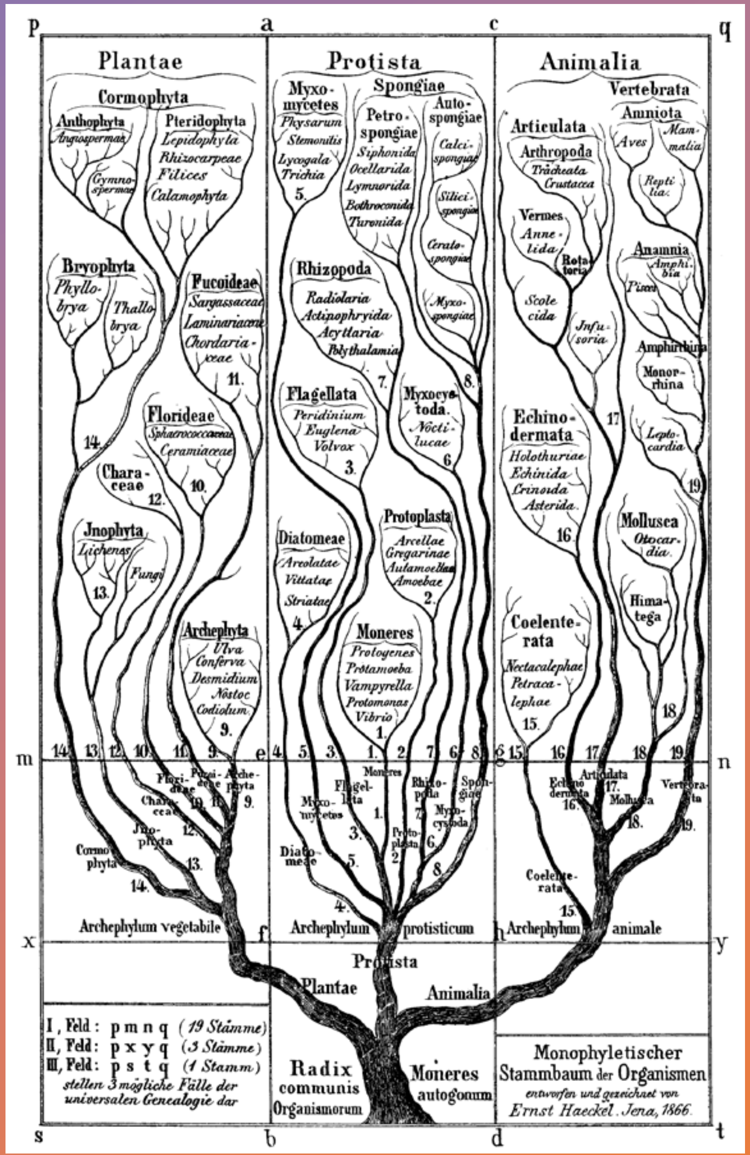
The right of Translation is reserved.

Contexto histórico

Teoria da Evolução - árvores evolutivas (filogenéticas)

Ernst Heinrich Philipp August Haeckel (1834, Potsdan – 1919, Jena)





Árvore genealógica representando três reinos da vida, do Volume II de ***Generelle Morphologie*** by Ernst Heinrich, de Haeckel (1866)

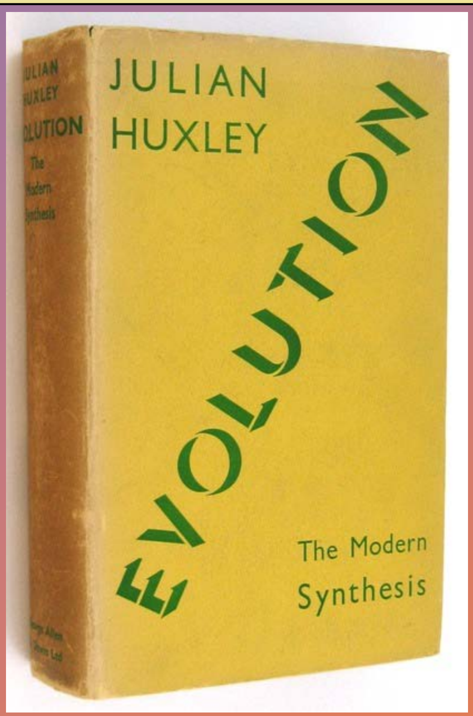
Contexto histórico

Taxonomia evolutiva ou gradismo

- *"Grade"* - táxon unido por um nível de complexidade morfológica ou fisiológica, em oposição ao "clade" (Julian Huxley - 1957)
- "*Grade*"- definido por uma característica geral, de "importância", determinada pelo especialista
- Ancestral não faz parte do "grade" (*e.g.*, Reptilia, Pisces); um grupo dá origem ao outro; o ancestral é real

Thomas Henry Huxley (Londres, 1825 — Sussex, 1895) – o 'buldogue' de Darwin

Thomas Huxley e ***Julian Huxley***, em 1895



Evolution: The Modern Synthesis (1942)

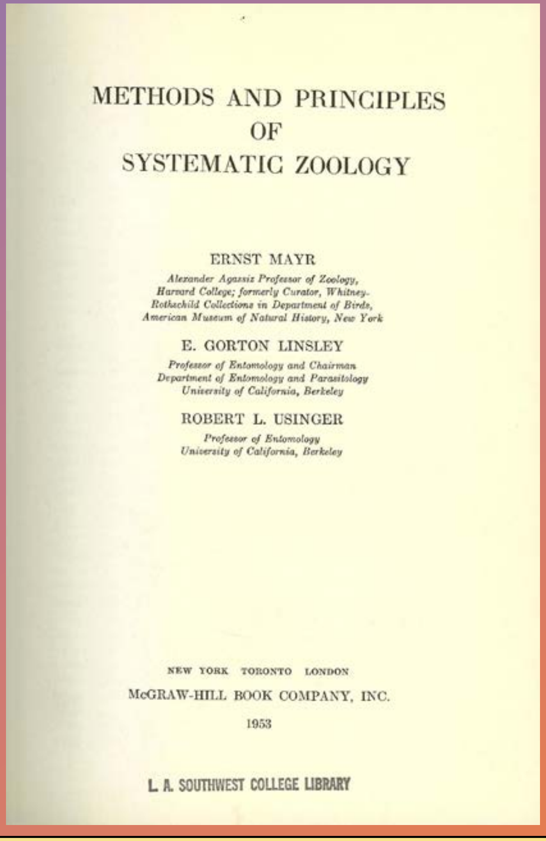
Julian Sorell Huxley (Londres, 1887 — Londres, 1975) – Oxford, King's College, UNESCO

Contexto histórico

Taxonomia evolutiva ou gradismo

- *Revolução conceitual* => síntese evolutiva moderna da genética mendeliana, sistemática e evolução darwiniana
- *Conceito biológico de espécie*.
- *Especiação peripátrica* (modelo com aves).
- Filosofia da biologia.

Ernst Walter Mayr (Kempten, 1904 — Bedford, EUA, 2005) - Harvard, Museu de História Natural de Berlim



METHODS AND PRINCIPLES
OF
SYSTEMATIC ZOOLOGY

ERNST MAYR
Alexander Agassiz Professor of Zoology, Harvard College; formerly Curator, Whitney-Rothschild Collections in Department of Birds, American Museum of Natural History, New York

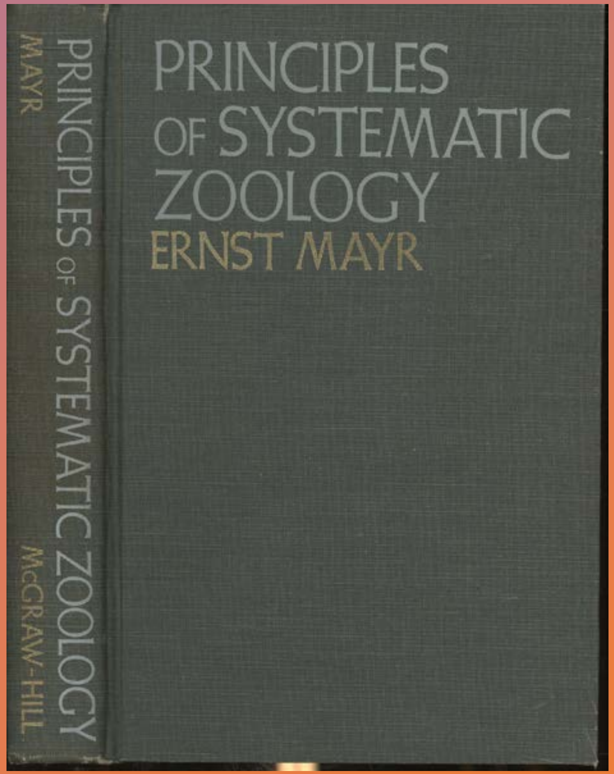
E. GORTON LINSLEY
Professor of Entomology and Chairman Department of Entomology and Parasitology University of California, Berkeley

ROBERT L. USINGER
Professor of Entomology University of California, Berkeley

NEW YORK TORONTO LONDON
McGRAW-HILL BOOK COMPANY, INC.
1953

L. A. SOUTHWEST COLLEGE LIBRARY

Mayr *et al.* (1953) ***Methods and Principles of Systematic Zoology***

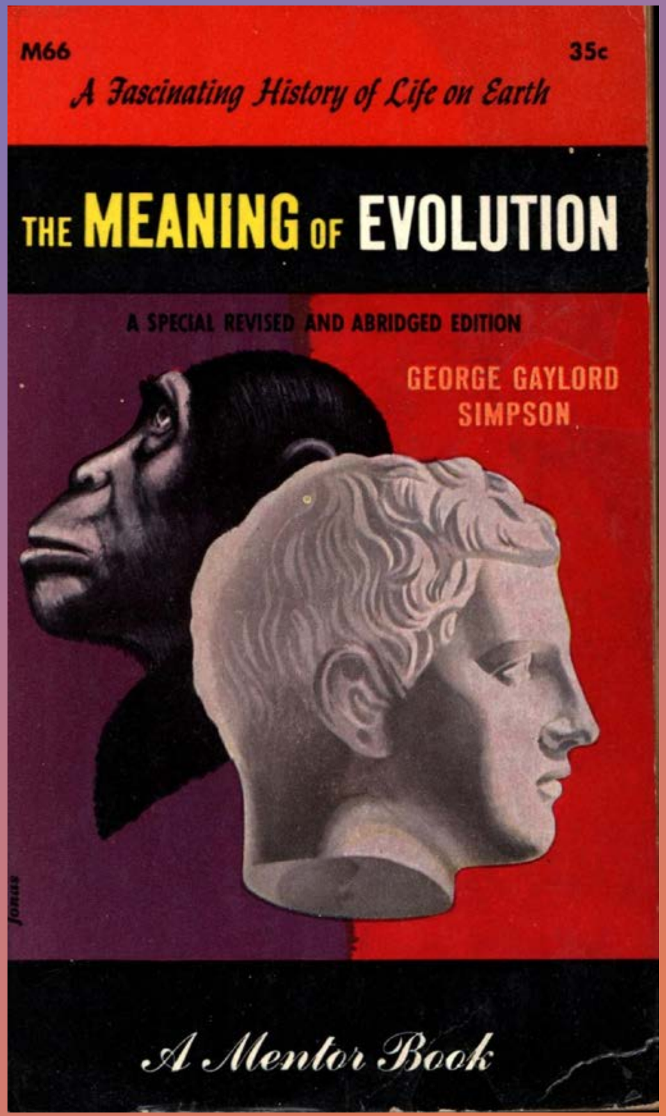


Mayr, E. **(1969)** ***Principles of Systematic Zoology***

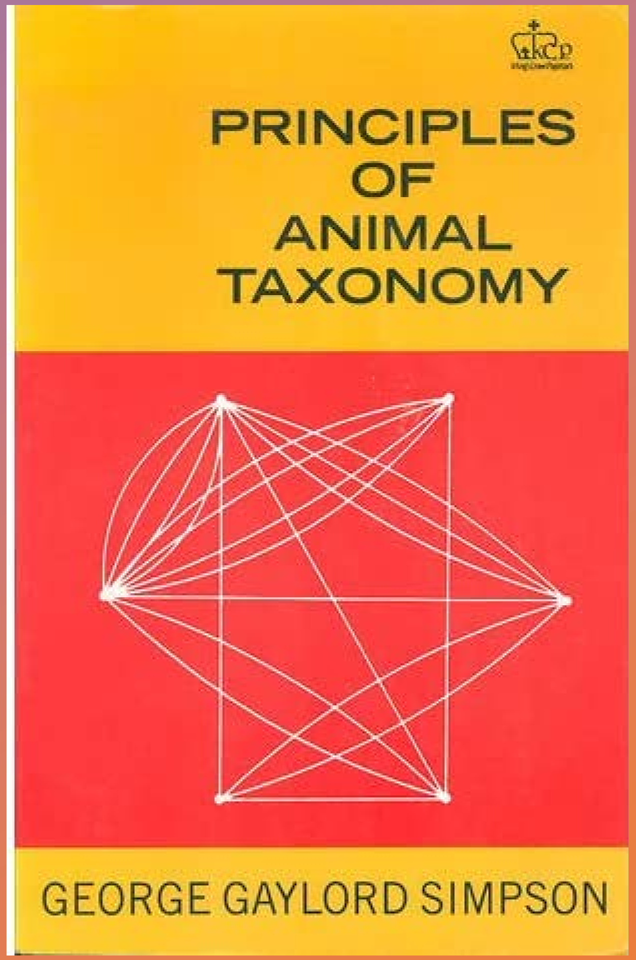
Contexto histórico

Taxonomia evolutiva ou gradismo

George Gaylord Simpson
(Chicago, 1902 — Tucson, 1984)
American Museum of Natural History, Museum of Comparative Zoology at Harvard University, University of Arizona



Simpson (1949, 1951), ***The Meaning of Evolution***



Simpson (1961), ***Principles of Animal Taxonomy***

Contexto histórico

Fenética ou *Taximetria => taxonomia numérica- princípios e práticas*

- *Classificar organismos com base na **semelhança geral**, geralmente na morfologia, **independentemente** de sua **filogenia** ou **relação evolutiva***

- ***Taxonomia numérica** - sistema de classificação que trata do **agrupamento** das **unidades taxonômicas** por métodos numéricos*

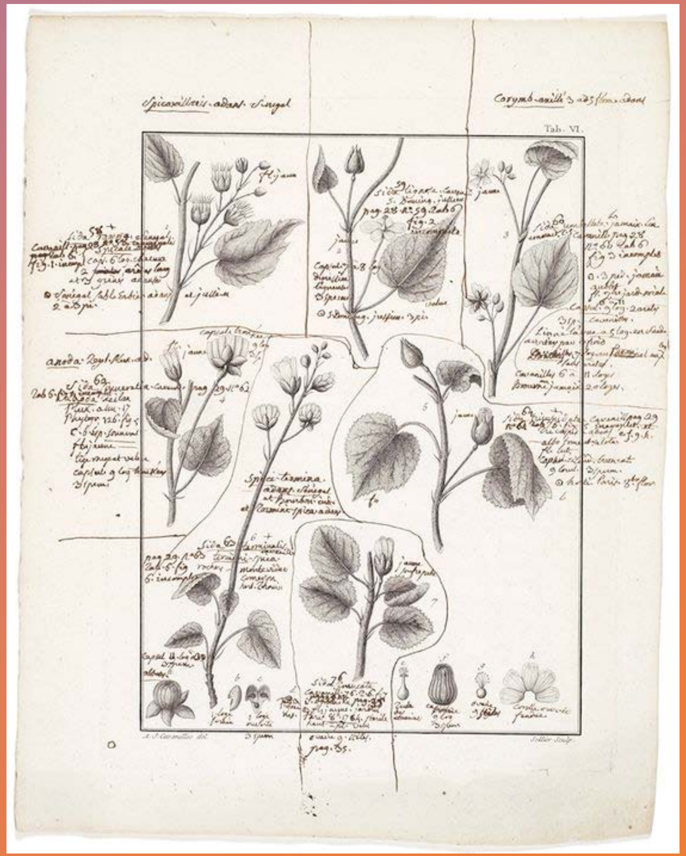
- *Surgiu na década de 1950; **Michel Adanson** (1727, Aix-en-Provence – 1806, Paris) – métodos quantitativos para organizar plantas e moluscos*

- *Aumento exponencial na complexidade de dados - acúmulo de informação anatômica e sobre a diversidade biológica*

- *Insatisfação com abordagens tradicionais (**gradismo**) para estabelecer relações filogenéticas ou classificações; ausência de método*

- *Popularização do uso de computadores para processar tarefas complexas*

***Michel Adanson** (Aix-en-Provence , 1727 — Paris, 1806)*



Contexto histórico

Fenética ou *Taximetria => taxonomia numérica- princípios e práticas*

- *Classificar organismos com base na **semelhança geral**, geralmente na morfologia, **independentemente** de sua **filogenia** ou **relação evolutiva***
- ***Taxonomia numérica** - sistema de classificação que trata do **agrupamento** das **unidades taxonômicas** por métodos numéricos*
- *Surgiu na década de 1950; **Michel Adanson** (1727, Aix-en-Provence – 1806, Paris) – métodos quantitativos para organizar plantas e moluscos*
- *Aumento exponencial na complexidade de dados - acúmulo de informação anatômica e sobre a diversidade biológica*
- *Insatisfação com abordagens tradicionais (**gradismo**) para estabelecer relações filogenéticas ou classificações; ausência de método*
- *Popularização do uso de computadores para processar tarefas complexas*

- ***Operational Taxonomic Unit (OTU)** (= Unidade Taxonômica Operacional) – é uma definição operacional usada para classificar grupos de indivíduos intimamente relacionados*
- ***UPGMA** - Unweighted Pair-Group Method using Arithmetic averages (= método de agrupamento de pares não ponderados usando médias aritméticas)*
- *Maior número de caracteres => melhor a classificação*
- *Todos os caracteres utilizados tem o mesmo peso na formação de agrupamentos*
- *Construção de tabelas de similaridade (proporções de presenças vs. ausências)*
- ***Simple Matching Co-efficient** => **SSM = NS/NS + ND X 100***

  ***NS** = número de caracteres similares coincidentes; **ND** = número de caracteres dissimilares*

Contexto histórico

Fenética ou *Taximetria => taxonomia numérica*

Robert Reuven Sokal
(1926, Viena – Stony Brook, NY, 2012) - University of Kansas; State University of New York, Stony Brook

THE UNIVERSITY OF KANSAS
SCIENCE BULLETIN
VOL. XXXVIII, PT. II] MARCH 20, 1958 [No. 22

A Statistical Method for Evaluating Systematic Relationships [1]

BY

ROBERT R. SOKAL and CHARLES D. MICHENER [2]
Department of Entomology
University of Kansas, Lawrence

Charles Duncan Michener
(1918, Pasadena - 2015, Lawrence) - *University of Kansas*; *University of California, Berkeley*

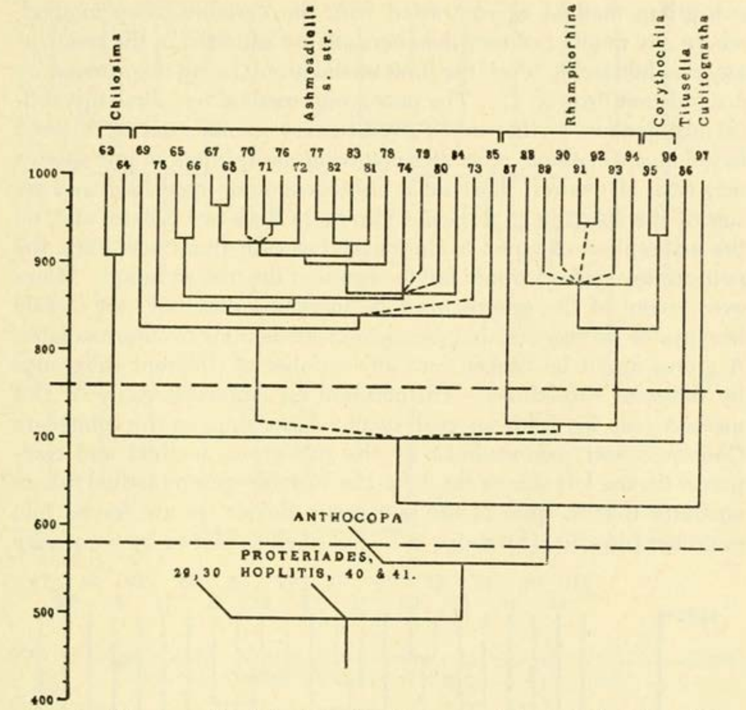
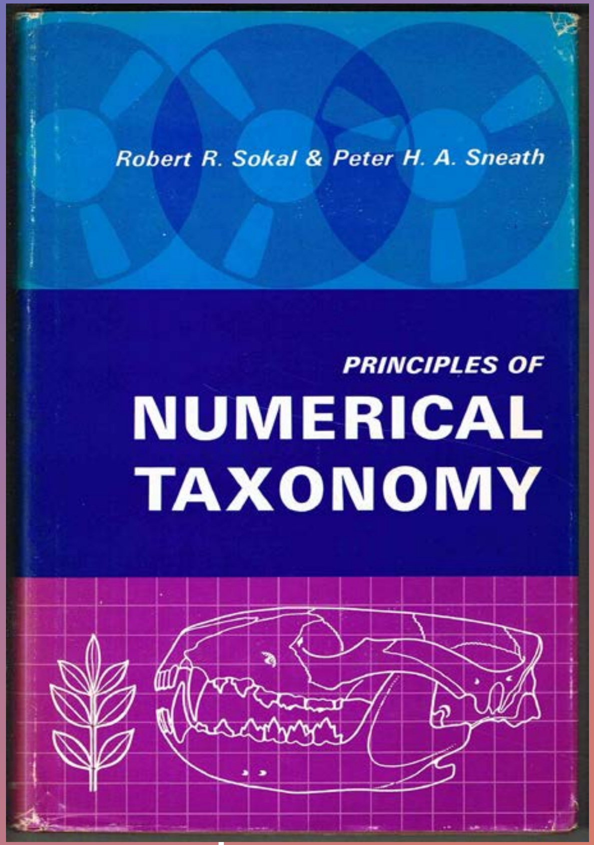


FIG. 1. Diagram of relationships for the genus *Ashmeadiella* obtained by the weighted variable group method. Ordinate: magnitude of correlation coefficient multiplied by 1000. Exact correlations between any two joining stems can be found by reading the value on the ordinate corresponding to the horizontal line connecting the stems. This value becomes approximate and maximal in cases of multifid furcations. Broken lines used where more than three stems join are for convenience only; the horizontal connecting line has the same significance as elsewhere. "Roofs" over species numbers at the summits of the lines delimit subgenera containing more than one species, as based on C. D. M.'s previous findings and not on this study. Generic names are in small capitals. The horizontal broken lines are not relevant to the present account; they are explained by Michener and Sokal (1957).

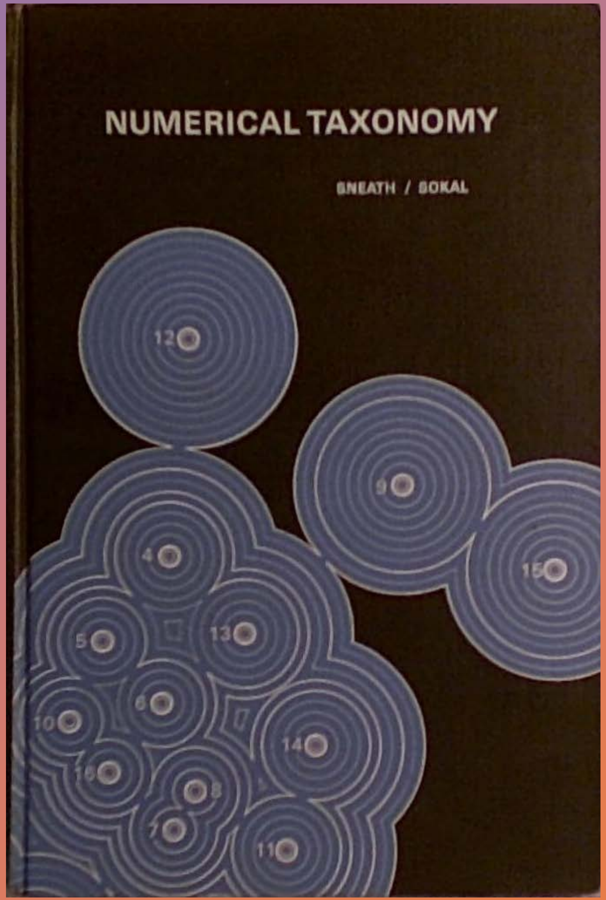
Contexto histórico

Fenética ou *Taximetria* => *taxonomia numérica*

Peter Henry A. Sneath
(1923–2011) - University of Cambridge



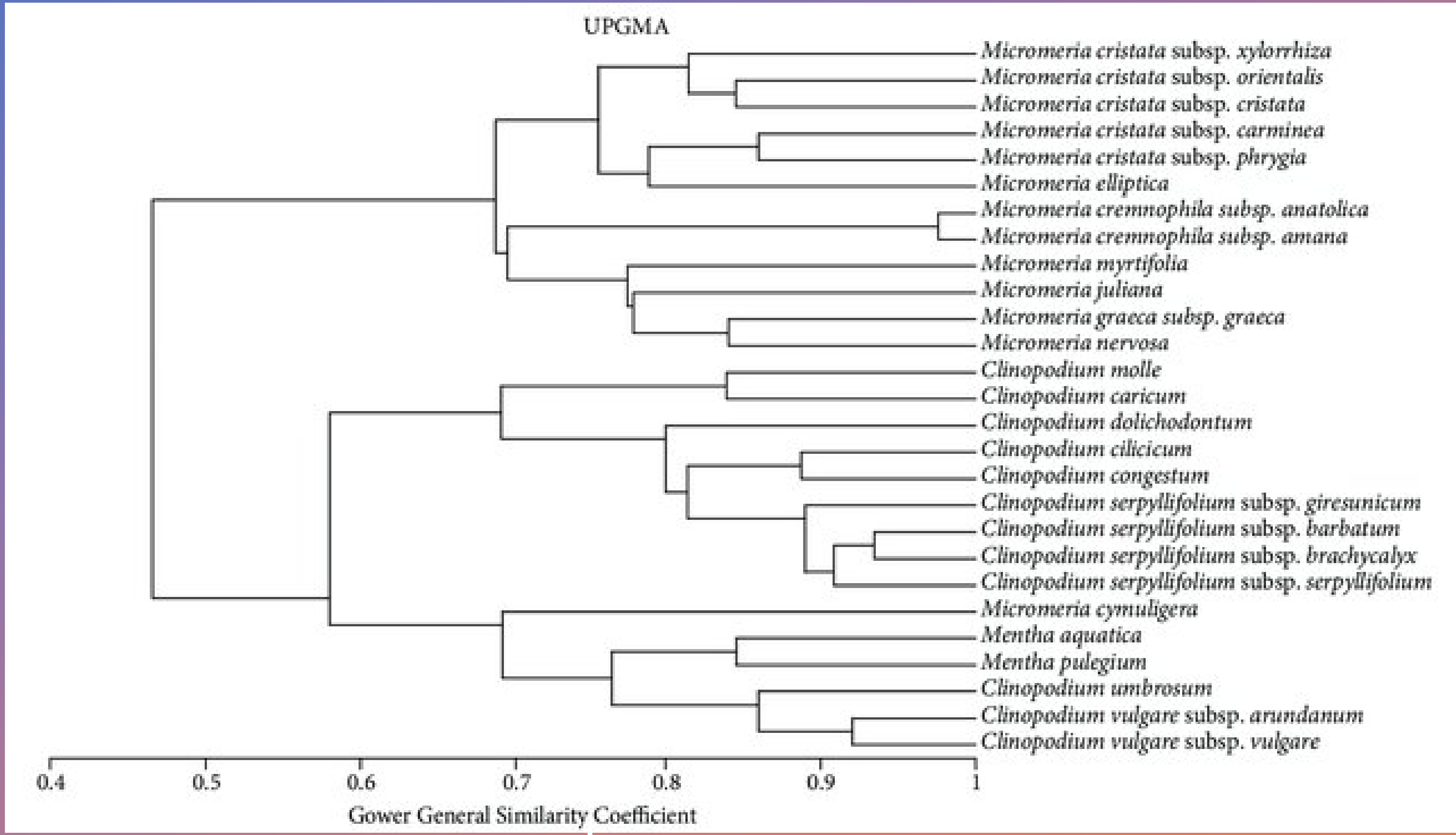
Sokal R.R. & Sneath P.H.E. (1963), *Principles of Numerical Taxonomy*



Sneath P.H.E. & Sokal R.R. & (1973), *Numerical Taxonomy: The Principles and Practice of Numerical*

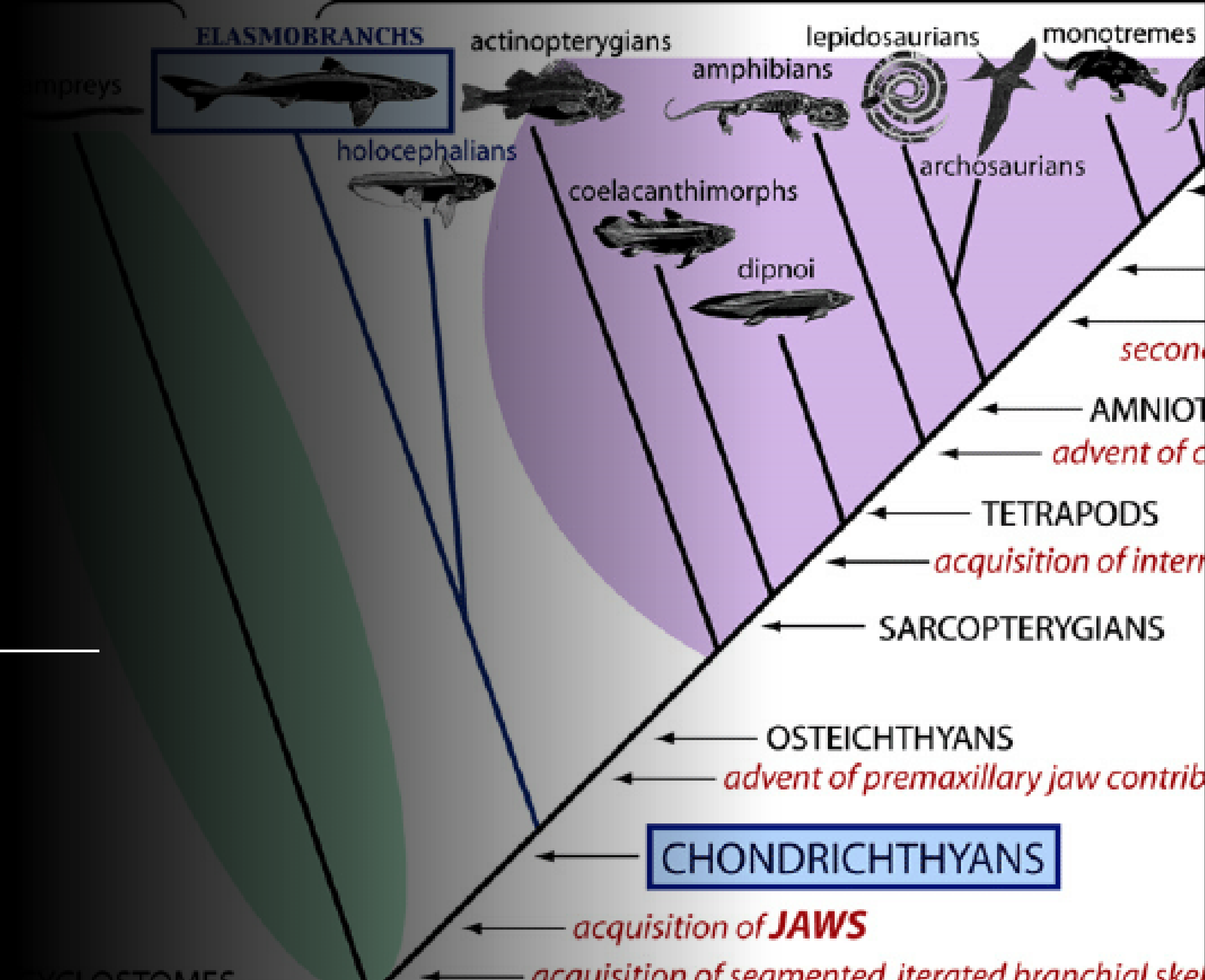
Contexto histórico

Fenética ou *Taximetria => taxonomia numérica*

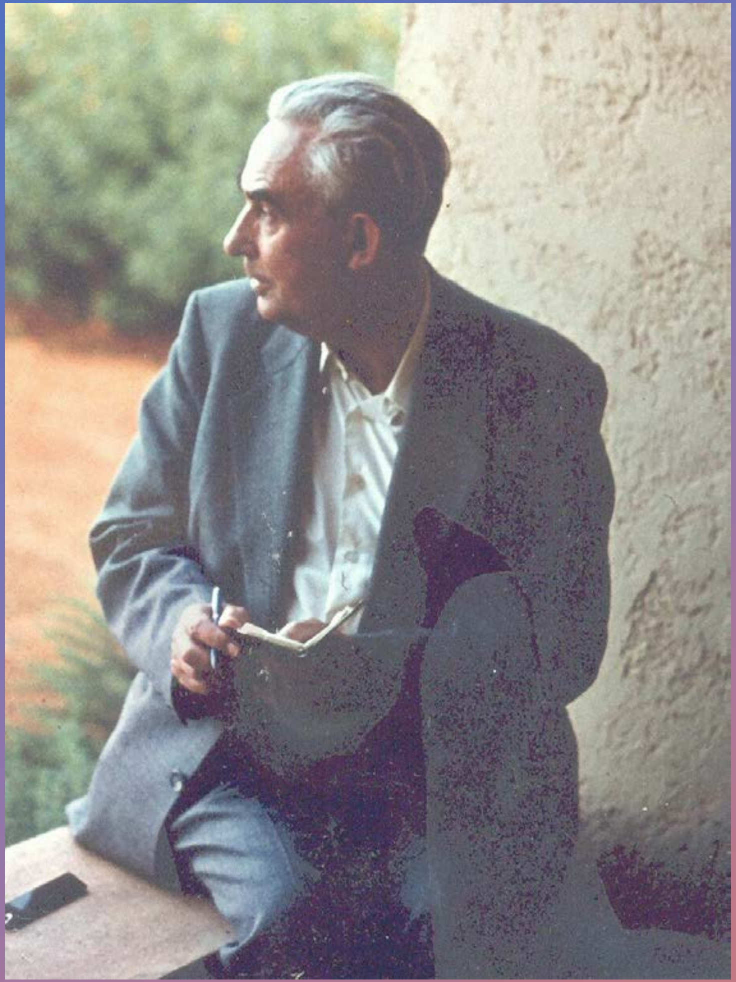


- ***Problemas:***
- *Não incorporava o paradigma evolutivo =>* ***fenogramas*** *objetivavam apenas representar classificações*
- *Uso de caracteres irrelevantes induzem a proporções altas de similaridade sem significado informativo*
- *Impossibilidade de se reproduzir os fenogramas, apesar da presumida objetividade*

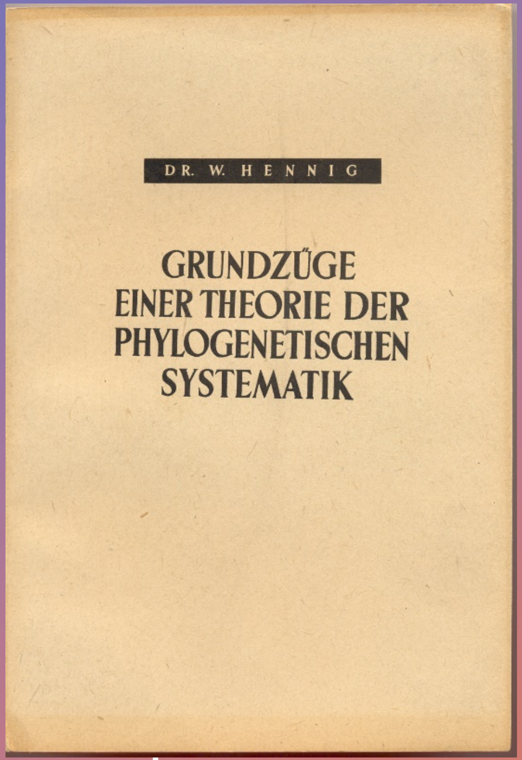
Sistemática Filogenética



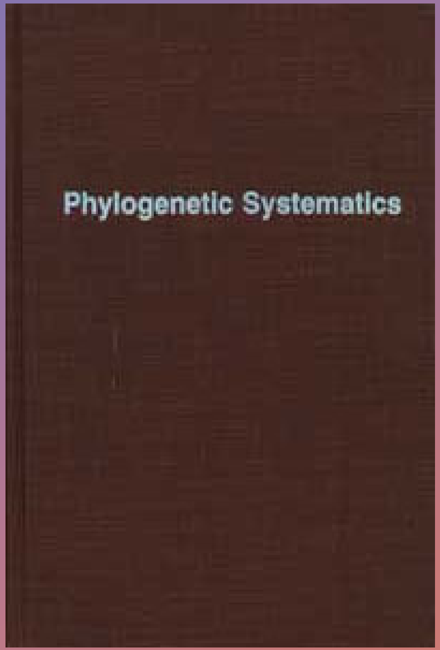
Sistemática Filogenética

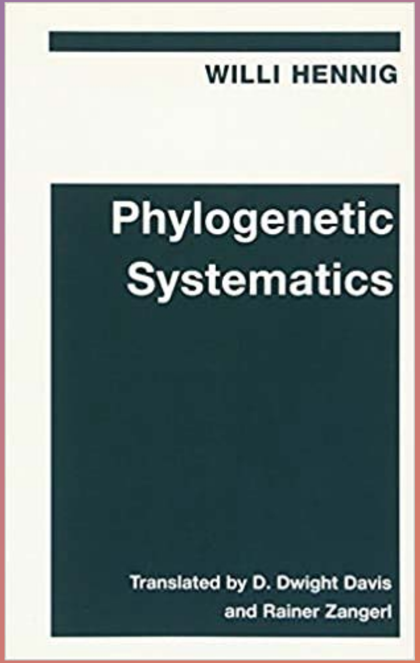


Willi Hennig (1913-1976)

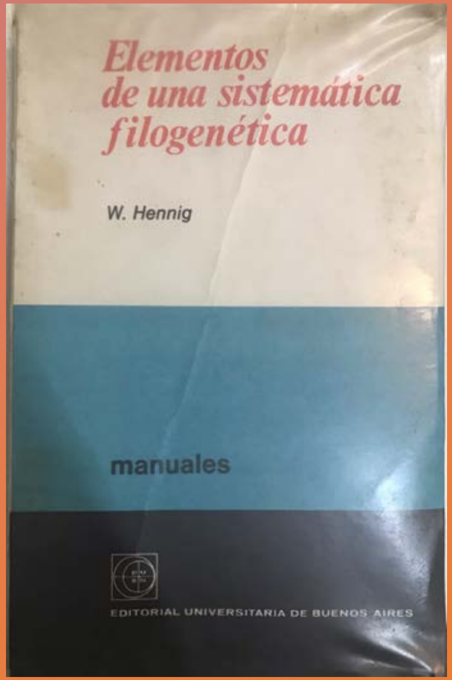


***Teoria geral da Sistemática Filogenética* (1950)**





***Phylogenetic Systematics* (1966, 1999)**

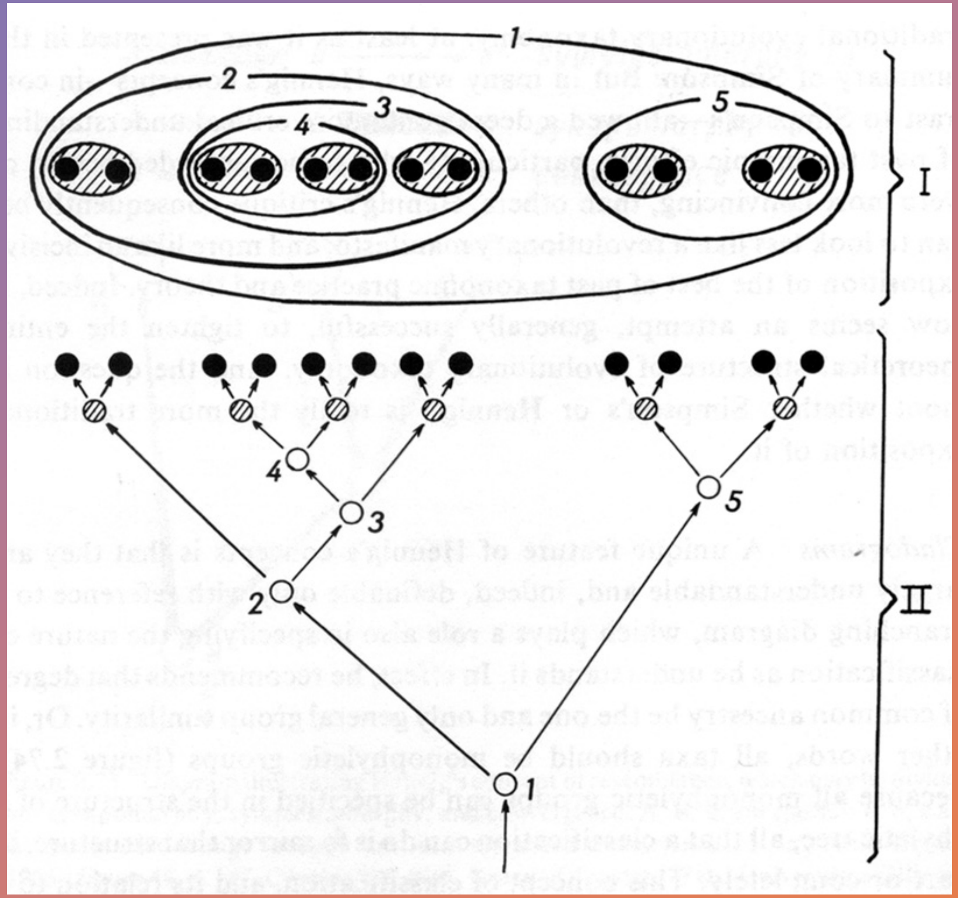


***Elementos de Una Sistemática Filogenética* (1968)**

Sistemática Filogenética

Princípios gerais

Willi Hennig (1913-1976)



***Teoria geral da Sistemática Filogenética* (1950)**

Sistemática Filogenética

Princípios gerais

– *Sistemática Filogenética: sistema geral de organização de toda informação biológica*

– *Relação de hierarquia entre as **espécies** e seus **ancestrais (hipotéticos)***

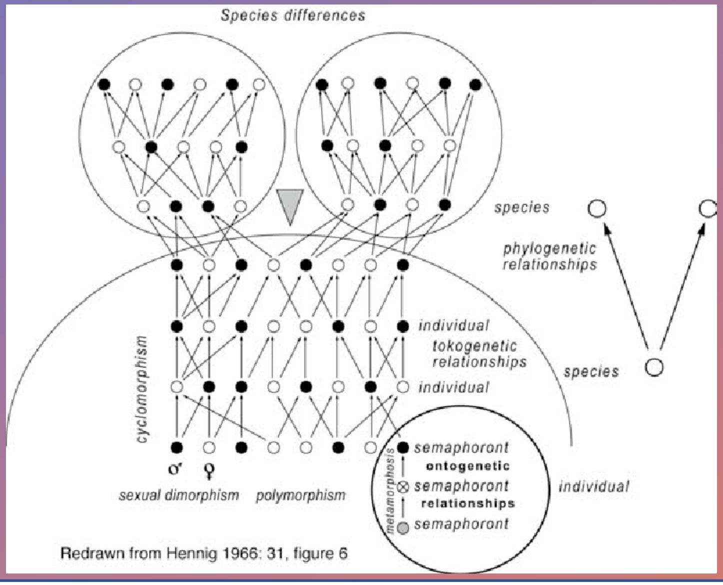
– *Reconhecimento da universalidade dos atributos – Hennig cunhou os termos **sinapomorfia**, **simplesiomorfia***

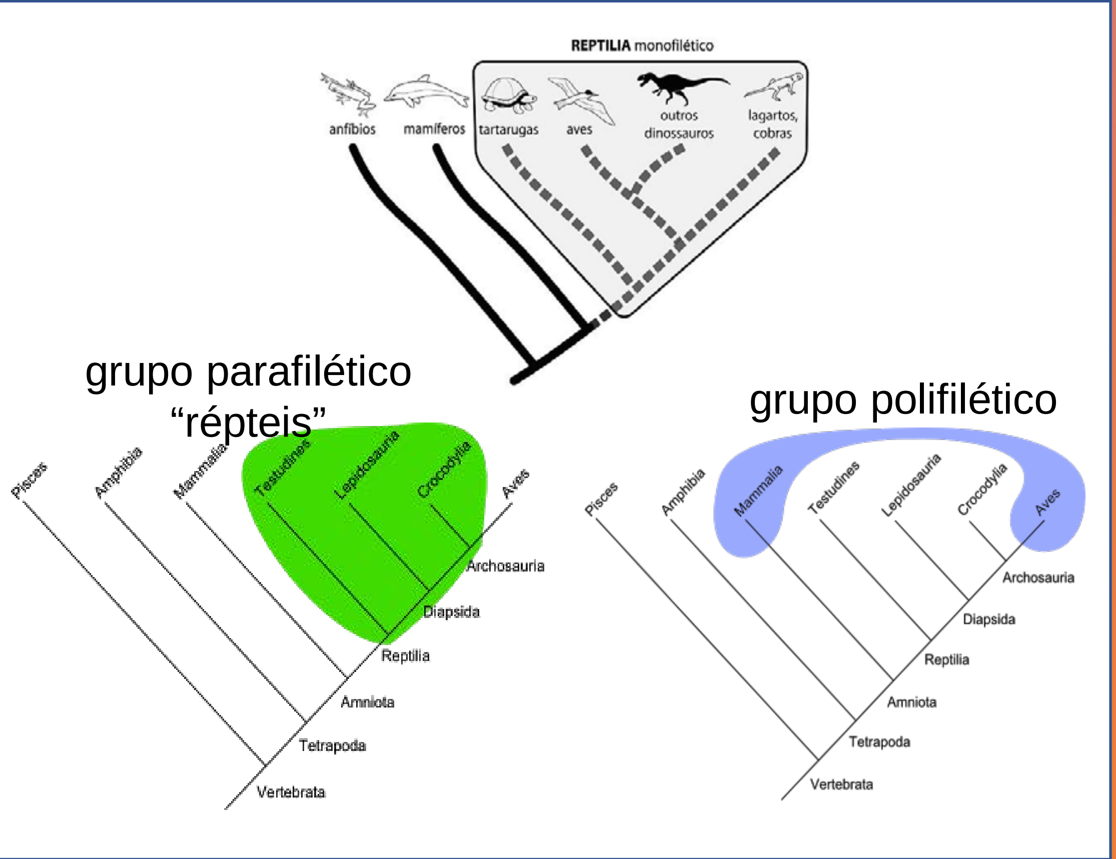
– *Diferentes escalas de relações (hologenéticas): no mesmo indivíduo (ontogenéticas - **semaforontes)**,* entre indivíduos (*tocogenéticas*), entre espécies (*filogenéticas*)

– ***Classificação** deve ser sempre baseada em **grupos monofiléticos** (compostos pelo ancestral direto e todos os seus descendentes); cunhou o termo **parafilia***

– ***Princípio auxiliar de Hennig** – "precursor do uso do princípio da parcimônia" – Navalha de Occam (ou Okham)*

– *Hennig não propôs nenhum método ou algoritmo para resolver conflitos entre os atributos*





Sistemática Filogenética

Princípios gerais

Annual Reviews
www.annualreviews.org/aronline

PHYLOGENETIC SYSTEMATICS[1]

By Willi Hennig
Staatliches Museum für Naturkunde in Stuttgart, Germany

Since the advent of the theory of evolution, one of the tasks of biology has been to investigate the phylogenetic relationship between species. This task is especially important because all of the differences which exist between species, whether in morphology, physiology, or ecology, in ways of behavior, or even in geographical distribution, have evolved, like the species themselves, in the course of phylogenesis. The present-day multiplicity of species and the structure of the differences between them, first becomes intelligible when it is recognized that the differences have evolved in the course of phylogenesis; in other words, when the phylogenetic relationship of the species is understood.

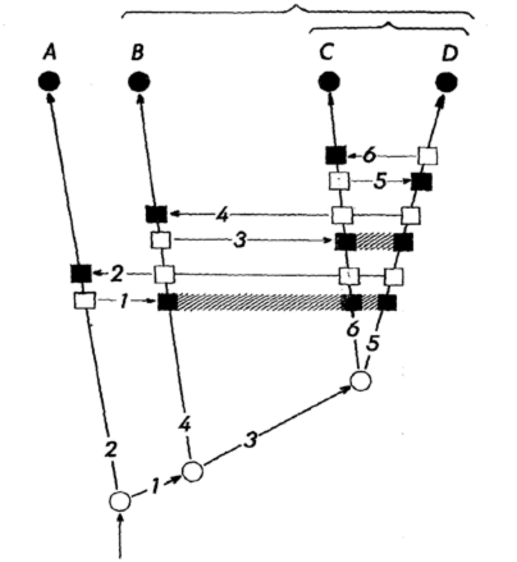


Fig. 3. Argumentation plan of phylogenetic systematics. □ plesiomorph, ■ apomorph expression of characters. Equal numbers indicate how sister-group relations are established by the distribution of relatively plesiomorph (white) and relatively apomorph (black) characters ("heterobathmy of characters"). Adapted from Hennig (11).

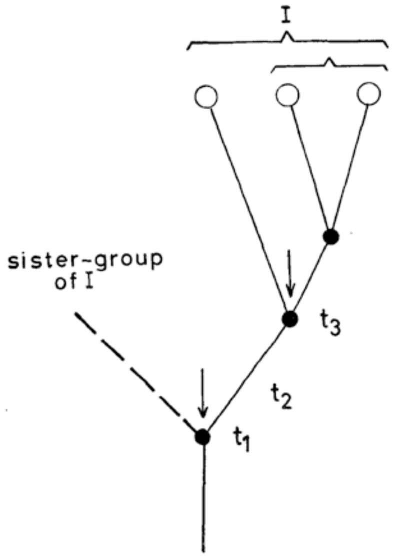


Fig. 4. The three different meanings of questions about the "age" of an animal group.
t_1 age of origin (separation of group I from its sister-group),
t_2 first appearance of the "typical" characters of group I,
t_3 age of division (last common ancestor of all recent species of group I)

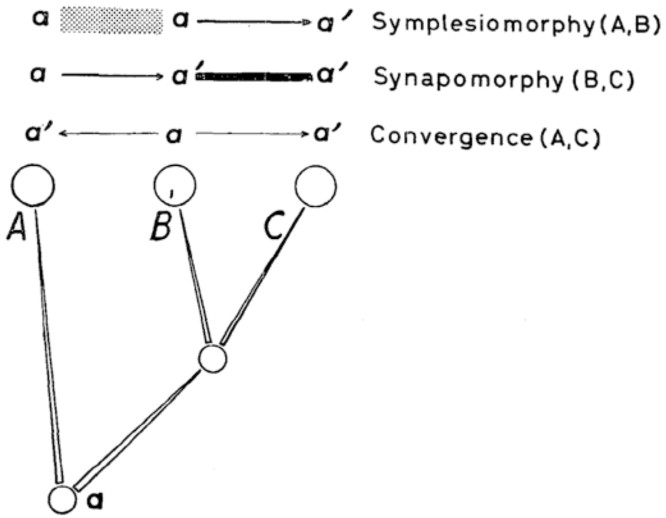


Fig. 1. The three different categories of morphological resemblance. *a* plesiomorph; *a'* apomorph expression of the morphological character *a*. Agreement may rest on sympleisiomorphy (*a-a*), synapomorphy (*a'-a'*) or convergence (*a'-a'*).

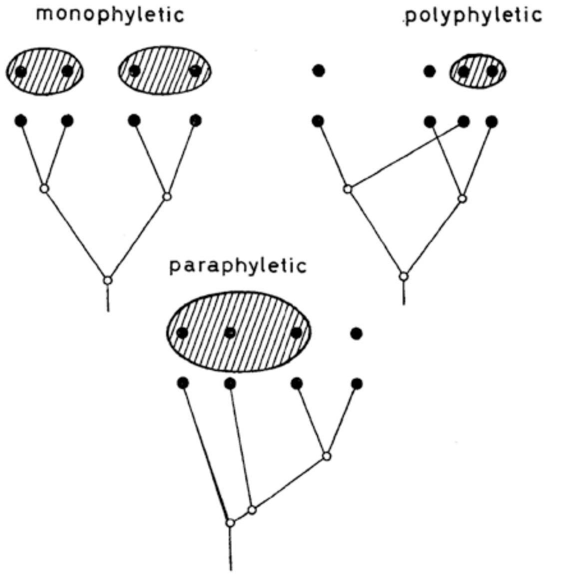


Fig. 2. The three different categories of systematic group formations corresponding to the resemblance of their constituents resting on synapomorphy (monophyletic groups), convergence (polyphyletic groups), or symplesiomorphy (paraphyletic groups). For comparison with Figure 1.

Hennig, W. (1965) Phylogenetic systematics. *Annual Review of Entomology, 10*: 97-116.

Sistemática Filogenética

Popularização da Sistemática Filogenética (décadas de 1970-1980)

Hans-Peter Schultze, Tor Orvig, Hans Bjerring, Erik Stensiö, Gareth J. Nelson, Chang Mee Mann, Ray Thorsteinsson**, **Erik Jarvik, Elga Mark-Kurik e ***Hans Jenssen***, no Dept. Paleontologia do Museu Sueco de História Natural, em Estocolmo, em jan/1967

Lars Zakarias Brundin (1907-1993)

Brundin, L. (1966) Transantarctic relationships and their significance, as evidenced by chironomid midges. ***Kungliga Svenska Vetenskapsakademiens Handlingar, Fjärde Serien, 11*** *(1): 1-472.*

Gareth J. Nelson (1937, Chicago -) - AMNH e University of Melbourne

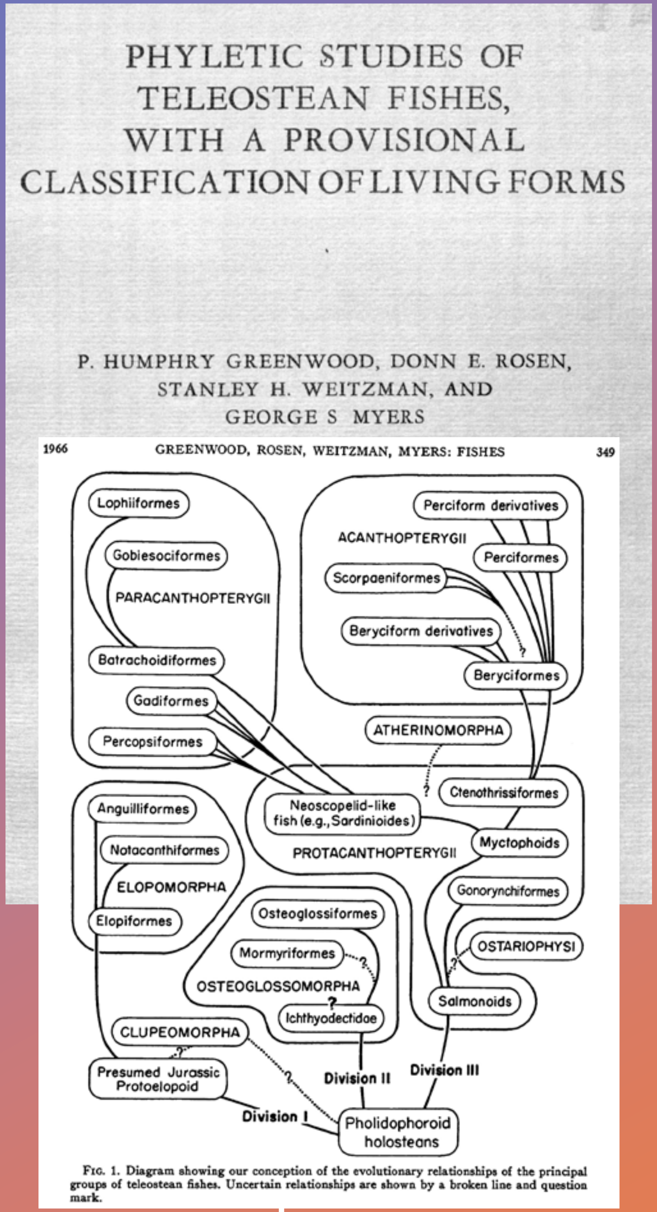
Lars Brundin (1907 - 1993) e ***Gareth J. Nelson*** (1937, Chicago -), no Museu Sueco de História Natural, em Estocolmo, em 1988

Sistemática Filogenética

Popularização da Sistemática Filogenética (décadas de 1970-1980)

Colin Patterson, British Museum
(1933, London – 1998, London)
British Museum of Natural History

Greenwood, P. H., Rosen, D. E., Weitzman, S. H. & Myers, G. S. (1966) Phyletic studies of teleostean fishes, with a provisional classification of living forms. *Bull. Am. Mus. Nat. Hist., 131*: 339-456.



PHYLETIC STUDIES OF TELEOSTEAN FISHES, WITH A PROVISIONAL CLASSIFICATION OF LIVING FORMS

P. HUMPHRY GREENWOOD, DONN E. ROSEN, STANLEY H. WEITZMAN, AND GEORGE S. MYERS

1966 GREENWOOD, ROSEN, WEITZMAN, MYERS: FISHES 349

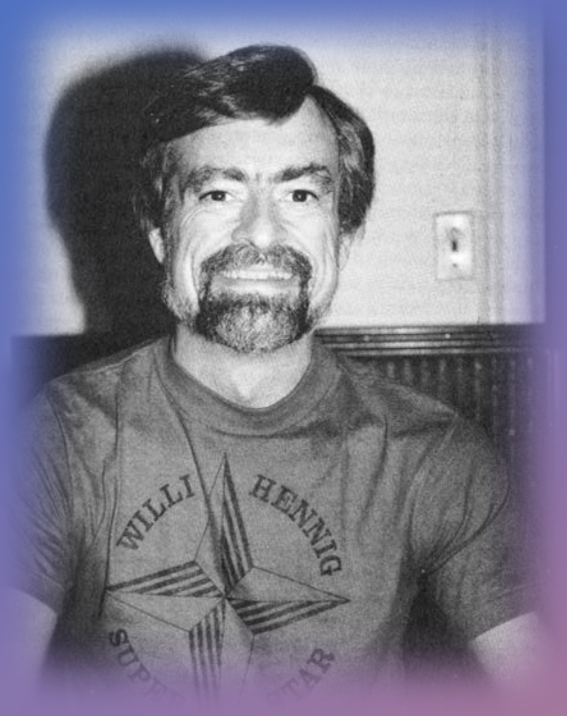
FIG. 1. Diagram showing our conception of the evolutionary relationships of the principal groups of teleostean fishes. Uncertain relationships are shown by a broken line and question mark.

Peter Humphry Greenwood
(1927, Redruth, Inglaterra –1995, London)
British Museum

Donn E. Rosen (1929, New York - 1986, Closter, NJ), ***Gareth J. Nelson*** (1937, Chicago -), ***Norman I. Platnick*** (Bluefield, 1951 – Filadélfia, 2020) -
American Museum of Natural History

Sistemática Filogenética

Primeiros desenvolvimentos da metodologia cladística



James S. Farris – State University of New York, Stony Brook, NY e Göteborgs botaniska trädgård, Suécia

QUANTITATIVE PHYLETICS AND THE EVOLUTION OF ANURANS

ARNOLD G. KLUGE AND JAMES S. FARRIS

Abstract

In the quantitative phyletic approach to evolutionary taxonomy, quantitative methods are used for inferring evolutionary relationships. The methods are chosen both for their operationism and for their connection to evolutionary theory and the goals of evolutionary taxonomy. As an example of this approach, a detailed analysis of a set of anuran characters is presented and taxonomic conclusions based on those characters are drawn. The methods and conclusions of the quantitative phyletic analysis are compared and contrasted with the methods of previous workers in the field of anuran classification.

Kluge, A. G., & J. S. Farris (1969) Quantitative phyletics and the evolution of anurans. *Systematic Zoology, 18* (1):1-32.

A SUCCESSIVE APPROXIMATIONS APPROACH TO CHARACTER WEIGHTING

JAMES S. FARRIS

Abstract

Farris, J. S. (Dept. Biol. Sci., State Univ., Stony Brook, New York 11790) 1969. A successive approximations approach to character weighting. Syst. Zool., 18:374–385.—Characters that are reliable for cladistic inference are those that are consistent with the true phyletic relationships, that is, those that have little homoplasy. A set of cladistically reliable characters are correlated with each other in a particular non-linear fashion here referred to as hierarchic correlation. Cladistically unreliable characters can be hierarchically correlated only by chance. A technique that infers cladistic relationships by successively weighting characters according to apparent cladistic reliability is suggested, and computer simulation tests of the technique are described. Results indicate that the successive weighting procedure can be highly successful, even when cladistically reliable characters are heavily outnumbered by unreliable ones. [Evolutionary taxonomy. Cladistics. Character weighting.]

Farris, J. S. (1969) A successive approximations approach to character weighting. *Systematic Zoology*, *18* (4): 374-385.

A NUMERICAL APPROACH TO PHYLOGENETIC SYSTEMATICS[1,2]

JAMES S. FARRIS, ARNOLD G. KLUGE, AND MICHAEL J. ECKARDT

Abstract

Farris, J. S. (Biol. Sci., State Univ., Stony Brook, New York, 11790), Kluge, A. G., and Eckardt, M. J. (Zool., Univ. Michigan, Ann Arbor 48104) 1970. A Numerical approach to phylogenetic systematics. Syst. Zool., 19:172–191.—Principles abstracted from Hennig (1966) are used as axioms to form a quantitative analog of phylogenetic systematics. A close connection is demonstrated between phylogenetics and most parsimonious trees. The compatibility of some existing clustering methods with the principles is discussed, and a new clustering technique, the Weighted Invariant Step Strategy (WISS) is described. Generalization of the axioms to the case where direction of evolution is not assumed is examined, and it is shown that the Wagner Method for estimating evolutionary trees is consistent with the generalized phylogenetic axioms.

Farris, J. S., Kluge, A. G., & Eckardt, M. J. (1970) A Numerical approach to phylogenetic systematics. *Systematic Zoology, 19* (2): 172-191.

Sistemática Filogenética

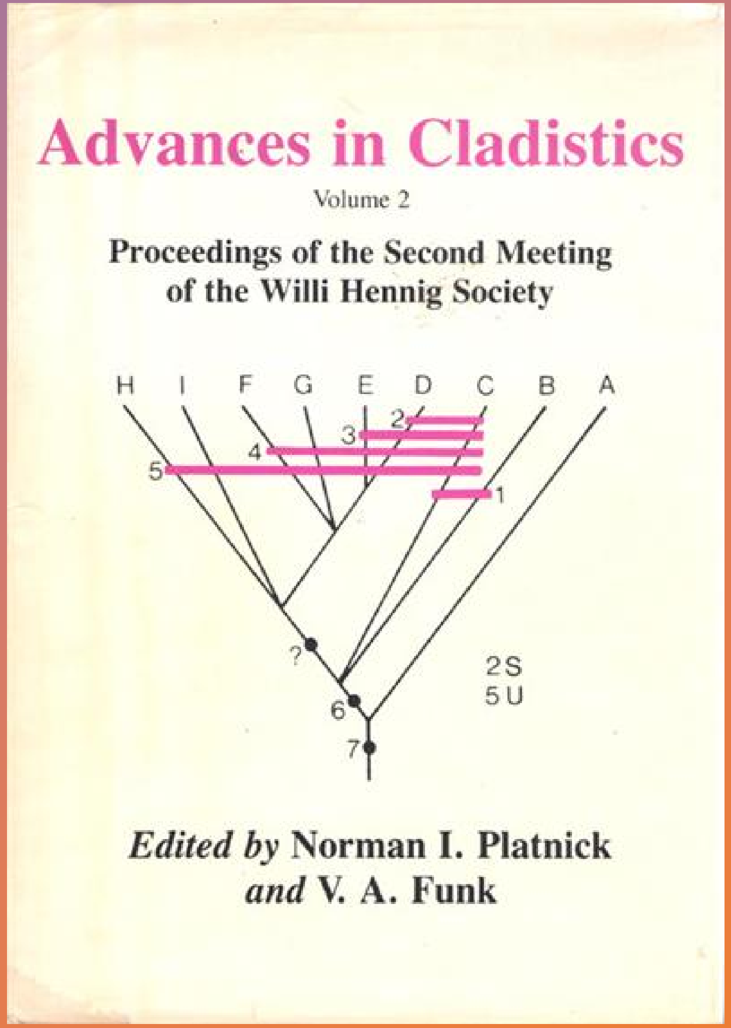
Primeiros desenvolvimentos da metodologia cladística

James S. Farris – State University of New York, Stony Brook, NY e Göteborgs botaniska trädgård, Suécia

The Logical Basis of Phylogenetic Analysis

James S. Farris

Table of Contents



Farris, J. S. (1983) The logical basis of phylogenetic analysis. Pp. 7-37, *in*: Platnick, N. I. & Funk, V. A. (Eds.), ***Advances in Cladistics. Volume 2. Proceedings the Second Meeting of the Willi Hennig Society***. New York, Columbia University Press

Sistemática Filogenética

Primeiros desenvolvimentos da metodologia cladística

Syst. Zool., 30(1), 1981, pp. 1–11

THE OUT-GROUP COMPARISON METHOD OF CHARACTER ANALYSIS

LARRY E. WATROUS AND QUENTIN D. WHEELER

Abstract

Watrous, Larry E., and Quentin D. Wheeler (Division of Insects, Field Museum of Natural History, Chicago, Illinois 60605, and Department of Entomology, Cornell University, Ithaca, New York 14853) 1981. The out-group comparison method of character analysis. Syst. Zool., 30:1–11.—An operational rule for analyzing character polarity with out-group comparison is presented and a series of observations, including potential problems in applying the rule, are discussed. The "commonality principle" (="frequency of occurrence," "common equals primitive") for determining character polarity is reviewed and dismissed as a reliable alternative to out-group comparison. Based on the rule and observations, a general method for character analysis is synthesized. [Cladistics; character analysis; out-group comparison; polarity.]

- Polarização: critério do grupo-externo (comum≠primitivo)

Larry E. Watrous – Field Museum of Natural History

Quentin Duane Wheeler (1954 -) - State Univ. New York College of Environ. Sci. and Forestry, Syracuse, NY

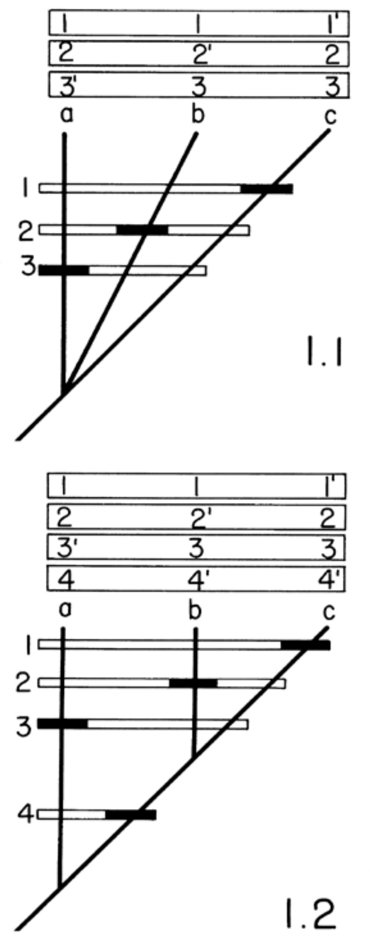


FIG. 1.—A three-taxon problem: fig. 1.1, where common equals primitive for all characters; fig. 1.2, where common equals derived for one character (4).

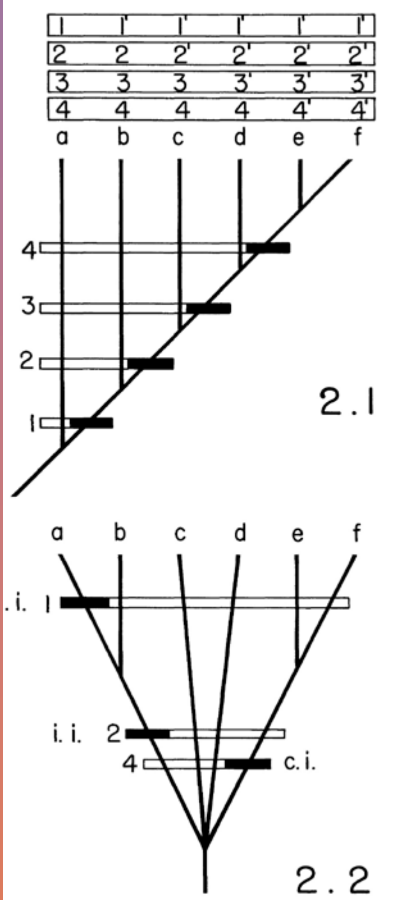


FIG. 2.—fig. 2.1, hypothetical cladogram showing actual (evolutionary) relationships; fig. 2.2, cladogram of same taxa as 2.1, based on common = primitive for all characters (characters 1 and 2 are incorrect inferences in this case).

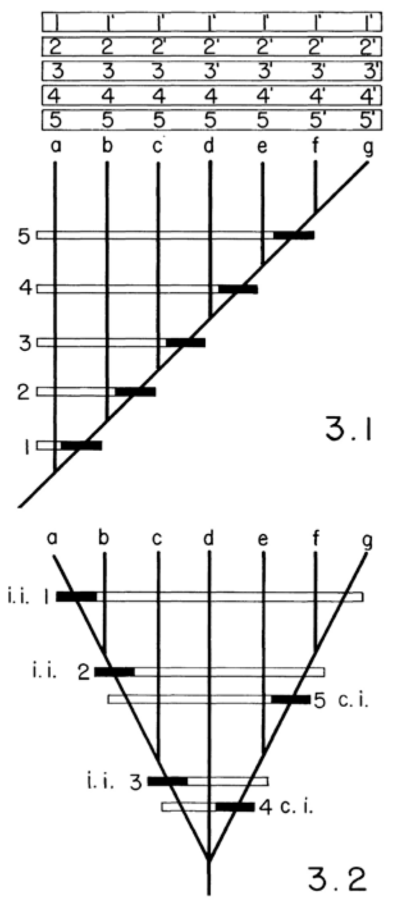


FIG. 3.—fig. 3.1, hypothetical cladogram showing actual (evolutionary) relationships; fig. 3.2, cladogram of same taxa as 3.1, based on common = primitive for all characters.

Watrous, L.E. & Wheeler, Q.D. (1981) The out-group comparison method of character analysis. ***Syst. Zool., 33***(1): 83-103.

Sistemática Filogenética

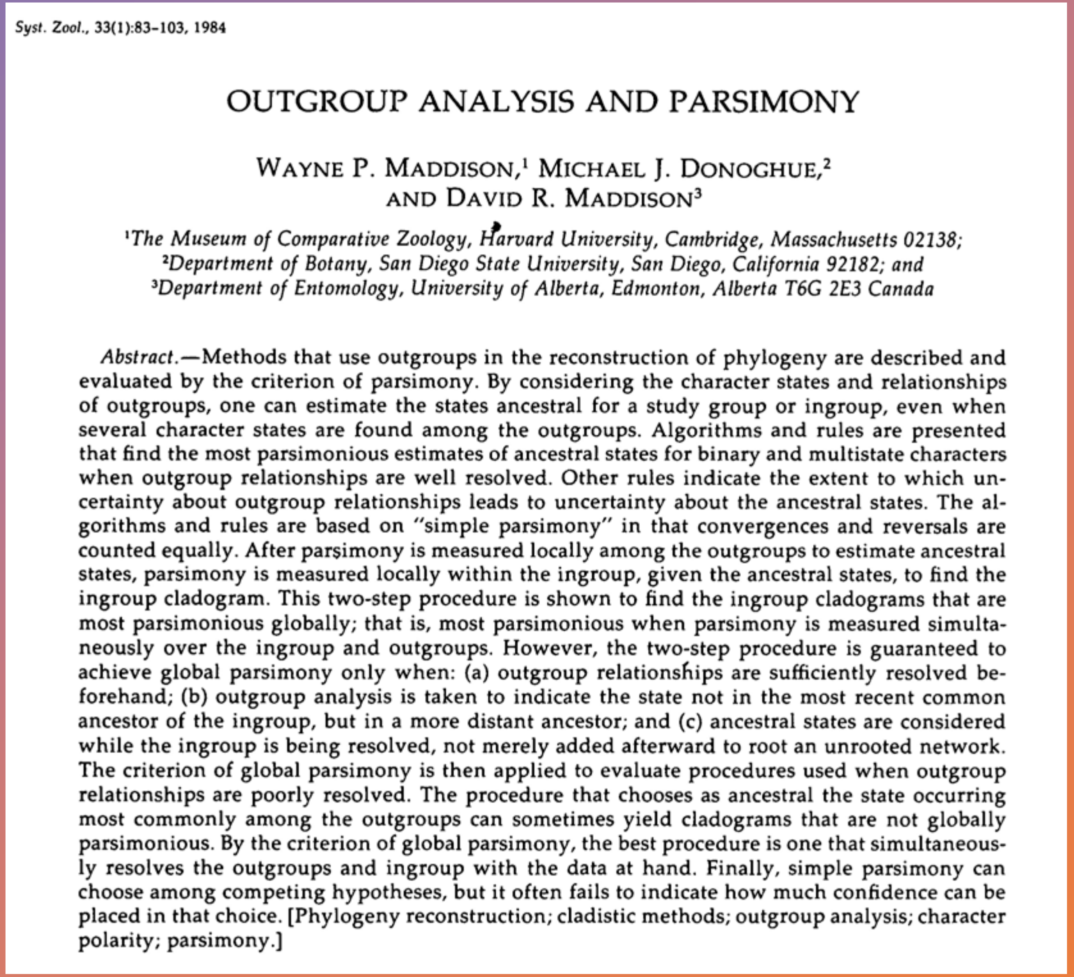
Primeiros desenvolvimentos da metodologia cladística

- Polarização: critério do grupo-externno /

Michael J. Donoghue – Universidade de Yale

Wayne P. Maddison – University of British Columbia

David R. Maddison – Oregon State University



Syst. Zool., 33(1):83–103, 1984

OUTGROUP ANALYSIS AND PARSIMONY

WAYNE P. MADDISON,[1] MICHAEL J. DONOGHUE,[2] AND DAVID R. MADDISON[3]

[1]*The Museum of Comparative Zoology, Harvard University, Cambridge, Massachusetts 02138;*
[2]*Department of Botany, San Diego State University, San Diego, California 92182; and*
[3]*Department of Entomology, University of Alberta, Edmonton, Alberta T6G 2E3 Canada*

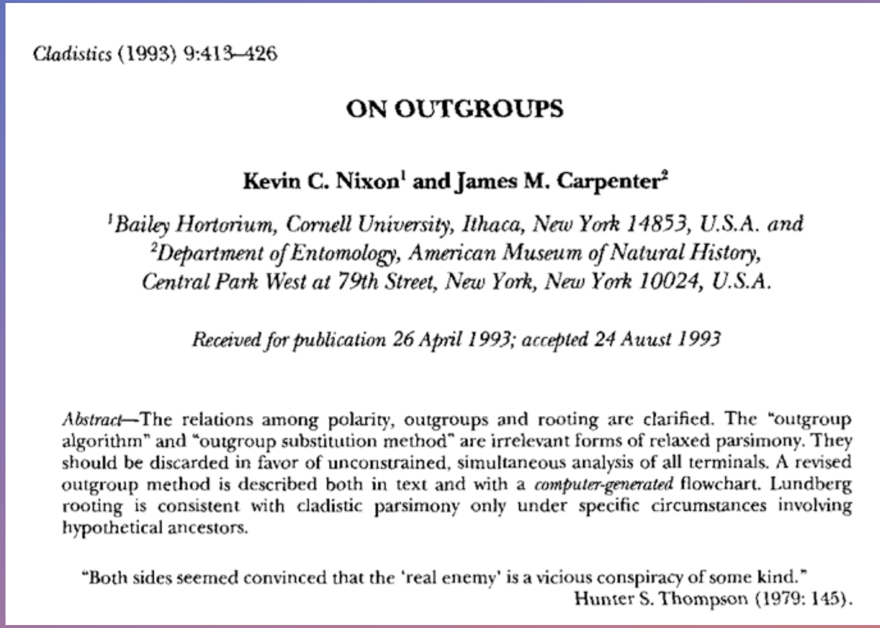
Abstract.—Methods that use outgroups in the reconstruction of phylogeny are described and evaluated by the criterion of parsimony. By considering the character states and relationships of outgroups, one can estimate the states ancestral for a study group or ingroup, even when several character states are found among the outgroups. Algorithms and rules are presented that find the most parsimonious estimates of ancestral states for binary and multistate characters when outgroup relationships are well resolved. Other rules indicate the extent to which uncertainty about outgroup relationships leads to uncertainty about the ancestral states. The algorithms and rules are based on "simple parsimony" in that convergences and reversals are counted equally. After parsimony is measured locally among the outgroups to estimate ancestral states, parsimony is measured locally within the ingroup, given the ancestral states, to find the ingroup cladogram. This two-step procedure is shown to find the ingroup cladograms that are most parsimonious globally; that is, most parsimonious when parsimony is measured simultaneously over the ingroup and outgroups. However, the two-step procedure is guaranteed to achieve global parsimony only when: (a) outgroup relationships are sufficiently resolved beforehand; (b) outgroup analysis is taken to indicate the state not in the most recent common ancestor of the ingroup, but in a more distant ancestor; and (c) ancestral states are considered while the ingroup is being resolved, not merely added afterward to root an unrooted network. The criterion of global parsimony is then applied to evaluate procedures used when outgroup relationships are poorly resolved. The procedure that chooses as ancestral the state occurring most commonly among the outgroups can sometimes yield cladograms that are not globally parsimonious. By the criterion of global parsimony, the best procedure is one that simultaneously resolves the outgroups and ingroup with the data at hand. Finally, simple parsimony can choose among competing hypotheses, but it often fails to indicate how much confidence can be placed in that choice. [Phylogeny reconstruction; cladistic methods; outgroup analysis; character polarity; parsimony.]

Maddison, W. P., Donoghue, M. J. & Maddison, D. R. (1984) Outgroup analysis and parsimony. ***Syst. Zool., 33***(1): 83-103.

Sistemática Filogenética

Primeiros desenvolvimentos da metodologia cladística

- Polarização: critério do grupo-externo


Cladistics (1993) 9:413–426

ON OUTGROUPS

Kevin C. Nixon[1] and James M. Carpenter[2]

[1]*Bailey Hortorium, Cornell University, Ithaca, New York 14853, U.S.A. and*
[2]*Department of Entomology, American Museum of Natural History, Central Park West at 79th Street, New York, New York 10024, U.S.A.*

Received for publication 26 April 1993; accepted 24 Auust 1993

Abstract—The relations among polarity, outgroups and rooting are clarified. The "outgroup algorithm" and "outgroup substitution method" are irrelevant forms of relaxed parsimony. They should be discarded in favor of unconstrained, simultaneous analysis of all terminals. A revised outgroup method is described both in text and with a *computer-generated* flowchart. Lundberg rooting is consistent with cladistic parsimony only under specific circumstances involving hypothetical ancestors.

"Both sides seemed convinced that the 'real enemy' is a vicious conspiracy of some kind."
Hunter S. Thompson (1979: 145).

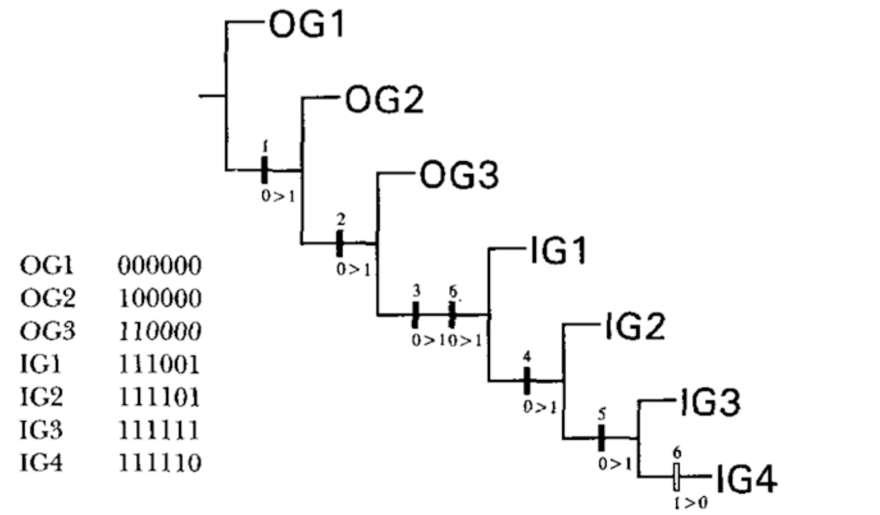


Fig. 1. Cladogram resulting from analysis of the hypothetical data set (see text).

Nixon, K.C. & Carpenter, J.M. (1993) On outgroups. *Cladistics, 9*: 413-426,

Sistemática Filogenética

Primeiros desenvolvimentos da metodologia cladística

ONTOGENY, PHYLOGENY, PALEONTOLOGY, AND THE BIOGENETIC LAW

GARETH NELSON

Abstract

Nelson, G. (Department of Ichthyology, The American Museum of Natural History, New York, New York 10024) 1978. Ontogeny, Phylogeny, Paleontology, and the Biogenetic Law. Syst. Zool. 27:324–345.—The biogenetic law is restated in a falsifiable form: given an ontogenetic character transformation, from a character observed to be more general to a character observed to be less general, the more general character is primitive and the less general advanced. The law, as restated, may be generally valid. In any case, the ontogenetic argument is a valid direct technique of character phylogeny; the anatomical argument ("outgroup comparison") is an indirect technique; the paleontological argument is of uncertain status. Falsification of all three types of arguments is explored in an analysis of L. Agassiz's concept of "threefold parallelism." Neoteny is a falsifier not of the biogenetic law, but of character phylogeny—of all three arguments. Phylogenetic reconstruction in its entirety appears to be an extrapolation of the orderliness of development. [Ontogeny; phylogeny; paleontology; biogenetic law; parsimony; falsification; Agassiz.]

- Polarização: critério ontogenético

TABLE 1. SEVEN COMPARISONS BETWEEN DIFFERENT TECHNIQUES OF CHARACTER PHYLOGENY.

	Generality		Element falsified		Apparent falsifier	
Comparisons	Greater	Lesser	No neoteny	Neoteny	No neoteny	Neoteny
1. Ontogeny	x	y	Anatomy	Ontogeny	Ontogeny	Anatomy
1. Anatomy	y	x				
2. Ontogeny	x	y	Paleontology	Ontogeny	Ontogeny	Paleontology
2. Paleontology	y	x				
3. Anatomy (+ Ontogeny)	x	y	Paleontology	Anatomy (+ Ontogeny)	Anatomy (+ Ontogeny)	Paleontology
3. Paleontology	y	x				
4. Paleontology (+) Ontogeny	x	y	Anatomy	Paleontology (+ Ontogeny)	Paleontology (+ Ontogeny)	Anatomy
4. Anatomy	y	x				
5. Ontogeny	x	y	Anatomy+ Paleontology	Ontogeny	Ontogeny	Anatomy+ Paleontology
5. Anatomy	y	x				
5. Paleontology	y	x				
6. Ontogeny	x	y	None	Ontogeny+ Anatomy+ Paleontology	None	None
6. Anatomy	x	y				
6. Paleontology	x	y				
7. Anatomy	m	n	None	None	None	None
7. Paleontology	n	m				

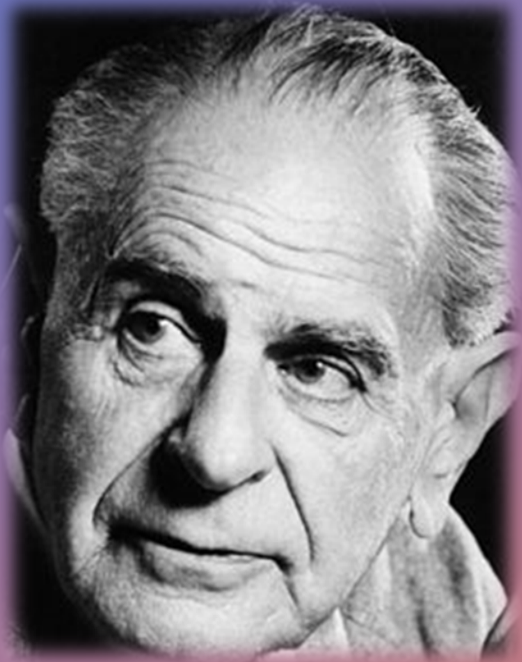
*A lei biogenética é restabelecida de uma forma **falseável**: dada uma transformação de um **caráter ontogenético**, de um caráter observado como mais geral para um caráter observado como menos geral, o **caráter mais geral é primitivo** e **o menos geral avançado**.*

Karl Ernst von Baer (Piibe, Estônia, 1792 — Tartu, Estônia, 1876)

Nelson, G. J. (1978) Ontogeny, phylogeny, paleontology, and the Biogenetic law. *Systematic Zoology, 27* (3): 324-345.

Sistemática Filogenética

Bases filosóficas



Karl R. Popper (1902, Vienna -1994, Londres)

- Critérios de demarcação entre ciência e não-ciência

- **Veracidade – confiabilidade no desenvolvimento do processo científico**
- **Testabilidade – replicação do experimento**
- ***Falseabilidade***

Popper, K. P. (1934) ***Logik der Forschung. Zur Erkenntnistheorie Der Modernen Naturwissenschaft***. Springer, *[= "A Lógica da Descoberta Científica. Sobre a epistemologia da ciência moderna."]*

Sistemática Filogenética

O Cladismo Transformado ou Cladismo de Padrão

- ***Cladogramas*** – são esquemas das informações cladísticas, organizadas pela princípio da parcimônia, independente do processo gerador subjacente
- ***Cladogramas*** – são representações atemporais; não representam cadeias de ancestrais – descendentes

PHILOSOPHY AND THE TRANSFORMATION OF CLADISTICS

NORMAN I. PLATNICK

Abstract

Platnick, N. I. (Department of Entomology, The American Museum of Natural History, New York, New York 10024) 1979. Philosophy and the transformation of cladistics. Syst. Zool. 28:537–546.—Although Hennig presented cladistic methods by referring to a model of the evolutionary process, neither the value nor the success of the methods is limited by the value or success of that evolutionary model. Dichotomous cladograms can be preferred simply on the basis of their maximal information content, without reference to speciation mechanisms. Because only the interrelationships of diagnosable taxa (those with unique sets of apomorphic characters) can be investigated, questions about whether speciation can occur without branching, or whether species become extinct at branching points, are irrelevant to cladistic practice. The distinction between plesiomorphic and apomorphic character states depends not on the reconstruction of actual evolutionary history, but on the discrimination of more general from less general characters; groups based on plesiomorphy are defined by the absence of characters and are therefore artificial. Hence cladistic methods are not the methods of phylogenetics *per se*, but the methods of natural classification in general; phylogenetic conclusions are an extrapolation from hypotheses about natural order. [Cladistics; phylogenetics; characters; natural classification.]

COLIN PATTERSON

British Museum (Natural History)
Cromwell Road
London SW7 5BD, England

Syst. Zool., 31(3), 1982, pp. 284–286

CLASSES AND CLADISTS OR INDIVIDUALS AND EVOLUTION

Norman I. Platnick (Bluefield, 1951 – Filadélfia, 2020) - American Museum of Natural History

FORUM

Cladistics 1(1):87–94

PHILOSOPHY AND THE TRANSFORMATION OF CLADISTICS REVISITED

NORMAN I. PLATNICK[1]

[1]*Department of Entomology, American Museum of Natural History, New York NY 10024*

Sistemática Filogenética

O Cladismo Transformado ou Cladismo de Padrão

Xilogravura da segunda edição de William Caxton de *Canterbury Tales* [= *Os Contos de Cantuária*] (1483) (Geoffrey Chaucer, 1387)

CLADISTIC METHODS IN TEXTUAL, LINGUISTIC, AND PHYLOGENETIC ANALYSIS

NORMAN I. PLATNICK AND H. DON CAMERON

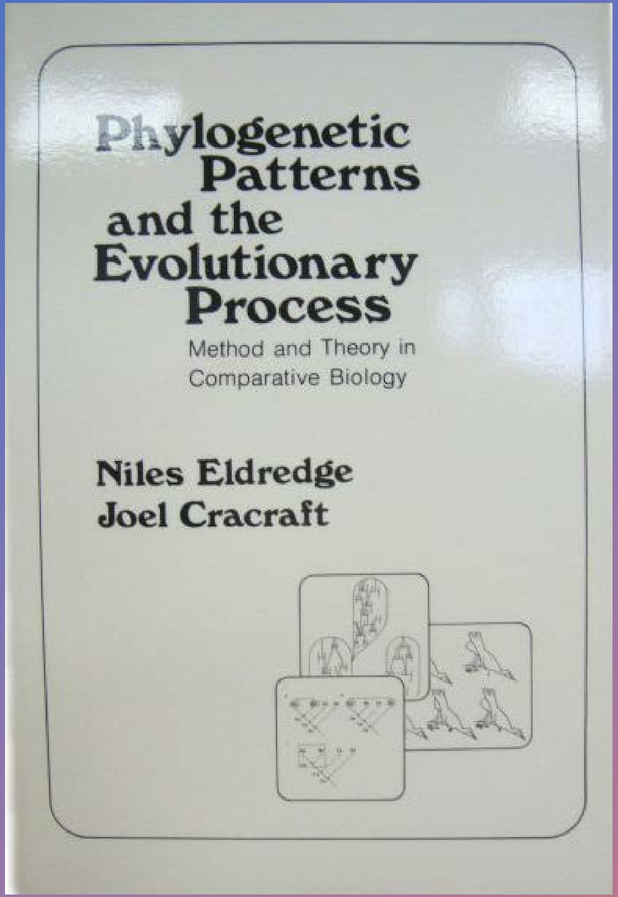
Abstract

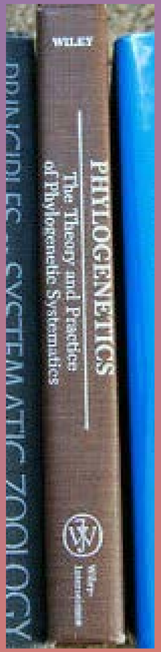
Platnick, N. I. (Department of Entomology, The American Museum of Natural History, New York, New York 10024) and H. D. Cameron (Department of Classical Studies and Museum of Zoology, The University of Michigan, Ann Arbor, Michigan 48104) 1977. Cladistic methods in textual, linguistic, and phylogenetic analysis. Syst. Zool. 26:380–385.—The concept that historical interrelationships can be demonstrated only by the presence of shared innovations is fundamental to the fields of textual and linguistic, as well as phylogenetic, reconstruction. All three fields utilize analogous procedures in which data are organized into transformation series of homologous character states, the polarity of these transformation series is determined by out-group comparison, and shared innovations are used to construct internested series of three-taxon statements that operate at a level of generality above that of specific ancestor-descendant hypotheses. The acceptance of these methods as the standard operational tools in separate fields suggests that cladistic analysis is a general comparative method applicable to all studies of historical interrelationships based on ancestor-descendant sequences, and that biologists concerned with such questions can ill afford to ignore cladistic theory and methods. [Phylogeny reconstruction; phylogenetic systematics; cladism.]

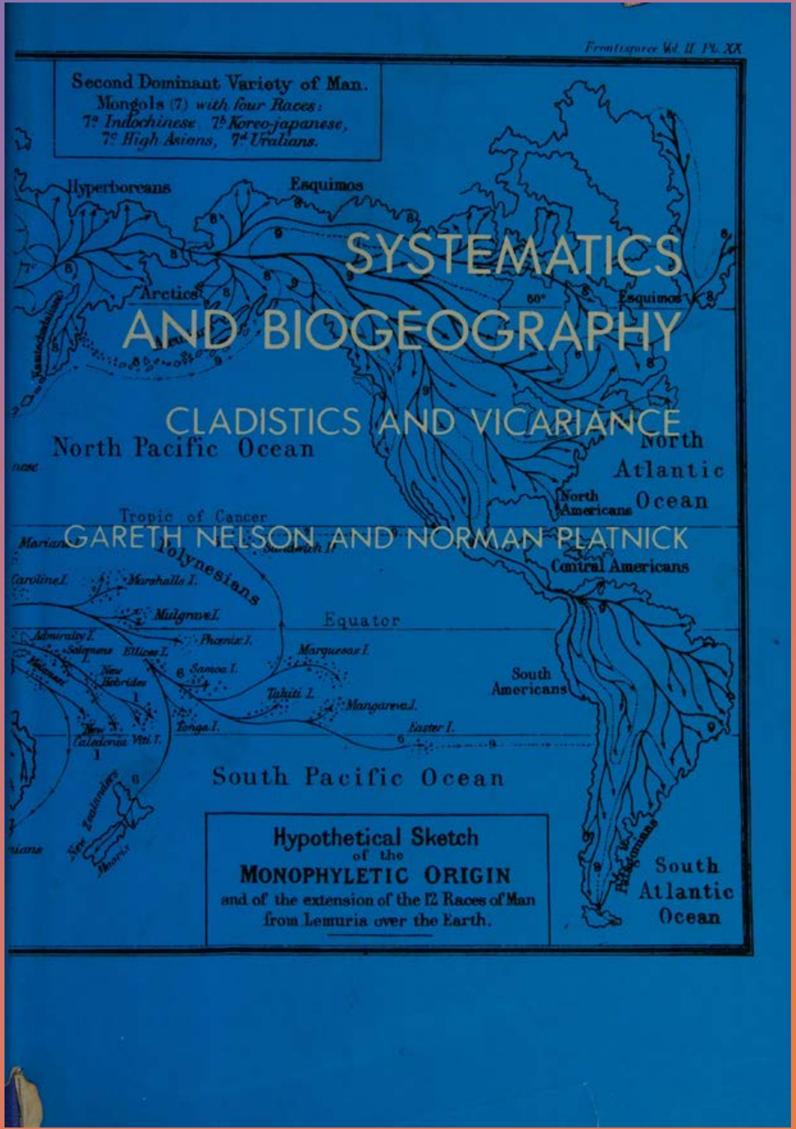
Platnick, N. I. & Don Cameron H. 1977. Cladistic methods in textual, linguistic, and phylogenetic analysis. ***Syst. Zool.*, 26** (4): 380-385.

Sistemática Filogenética

O Cladismo Transformado ou Cladismo de Padrão







Eldredge & Cracraft (1980), ***Phylogenetic Patterns and the Evolutionary Process. Method and Theory in Comparative Biology***

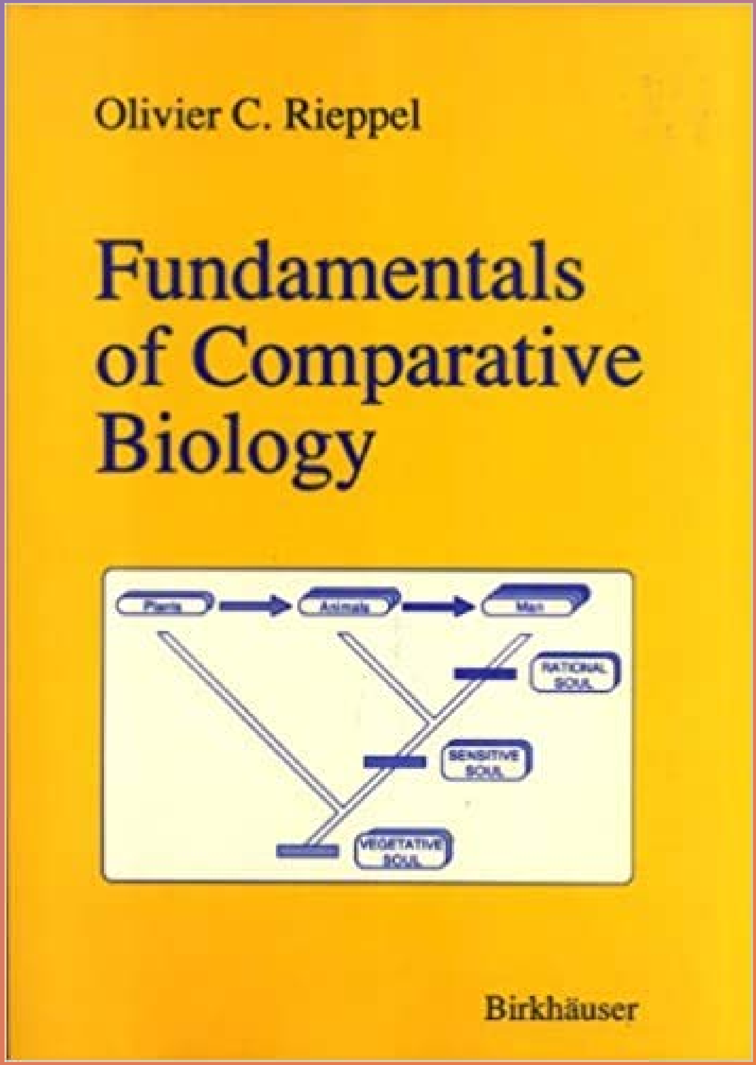
Wiley (1981), ***Phylogenetics: Theory and Practice of Phylogenetic Systematics***

Nelson & Platnick (1981), ***Systematics and Biogeography: Cladistics and Vicariance – "livro azul"***
- Tempo, Forma, Espaço

Sistemática Filogenética

Desenvolvimentos teóricos da Cladística na década de 1980

Olivier C. Rieppel - Field Museum of Natural History



Rieppel, O. C. (1988) ***Fundamentals of Comparative Biology***. Basel, Birkhauser, 202 p.