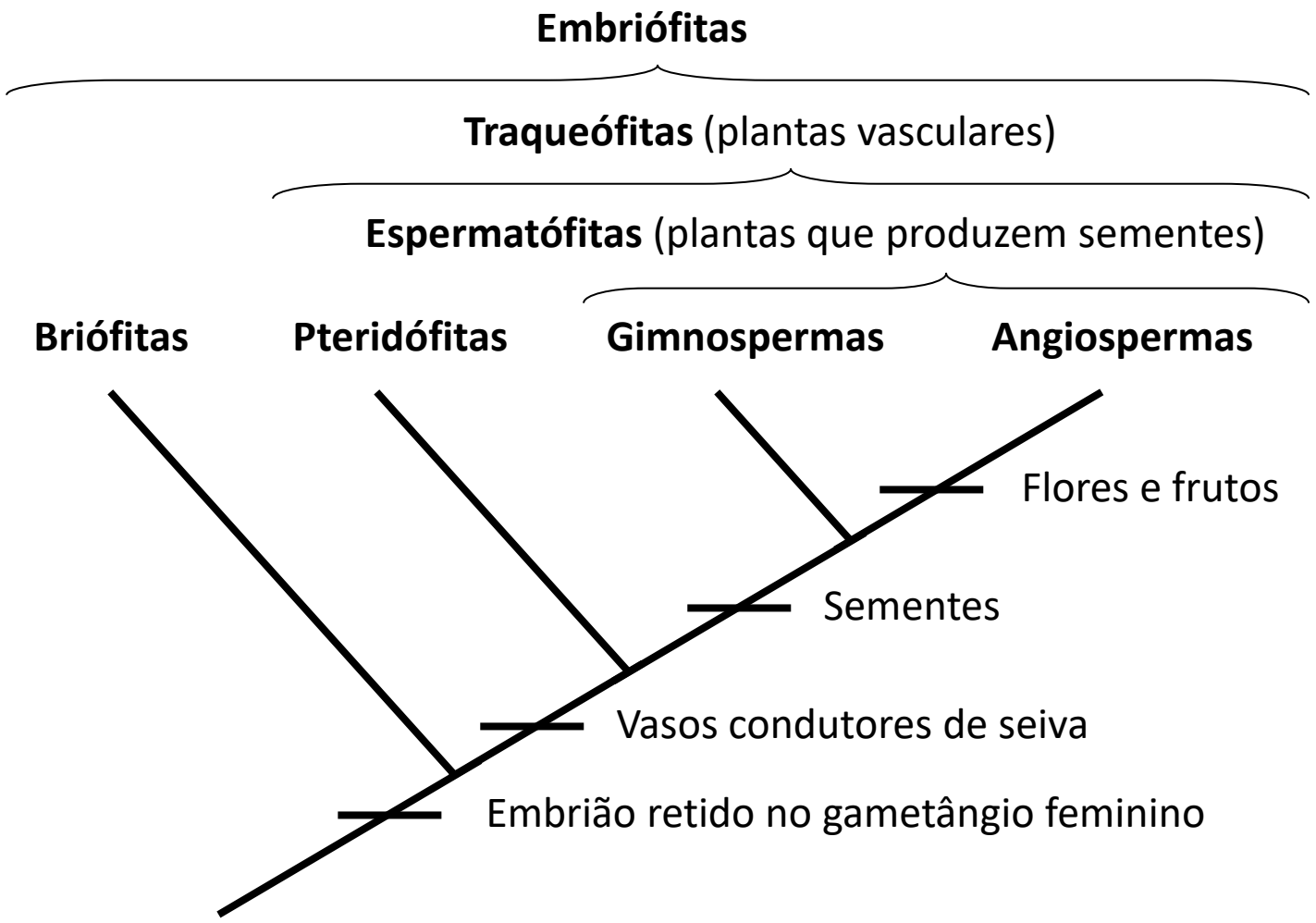
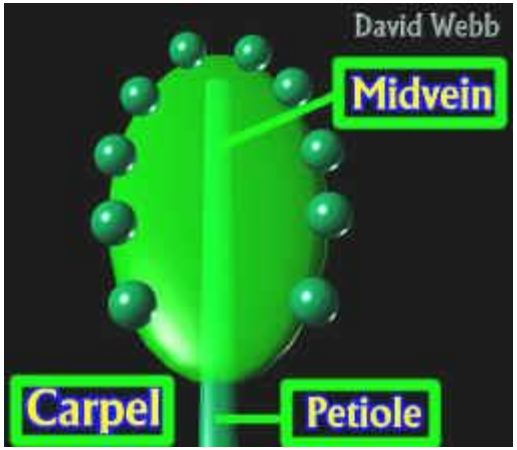
GIMNOSPERMAS



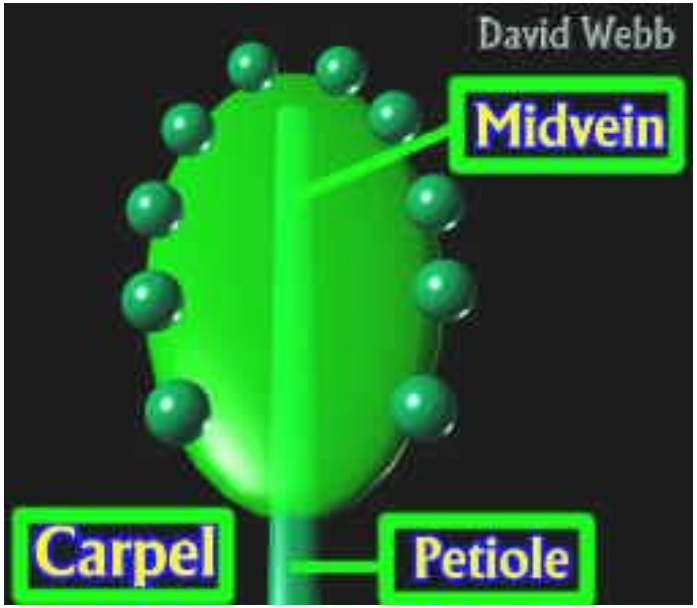

Embriófitas
Traqueófitas (plantas vasculares)
Espermatófitas (plantas que produzem sementes)
Briófitas
Pteridófitas
Gimnospermas
Angiospermas
Flores e frutos
Sementes
Vasos condutores de seiva
Embrião retido no gametângio feminino

Gimnospermas

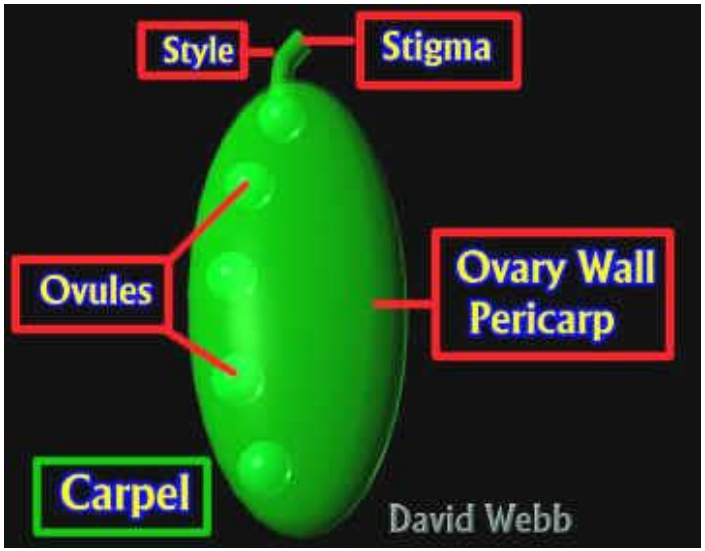
- O que é uma gimnosperma?
- Planta que produz sementes.
- Planta cujos óvulos (estrutura da flor que contem o gametófito feminino e que se transforma em uma semente) estão expostos no momento da fertilização.


David Webb
Midvein
Carpel
Petiole

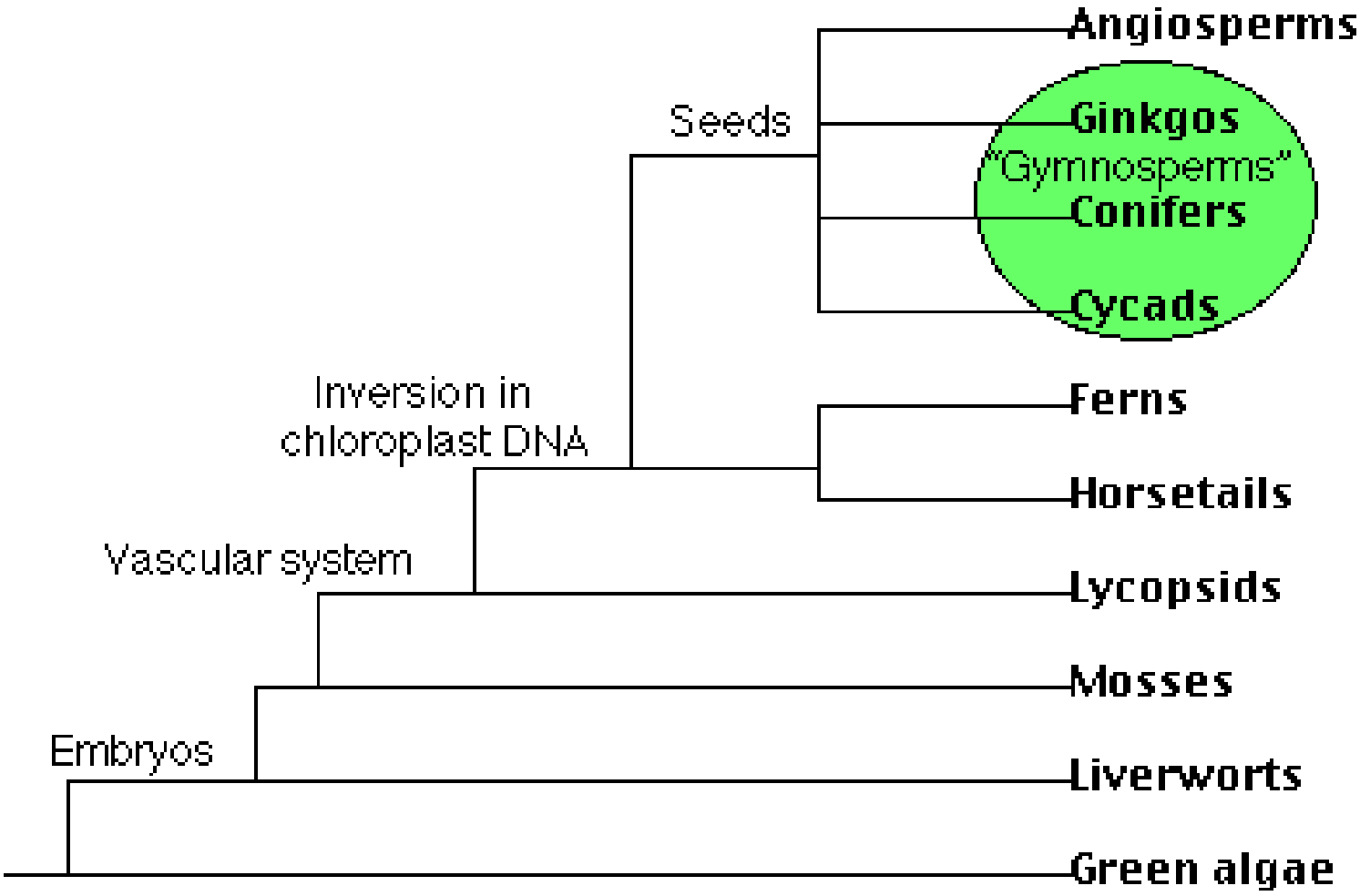


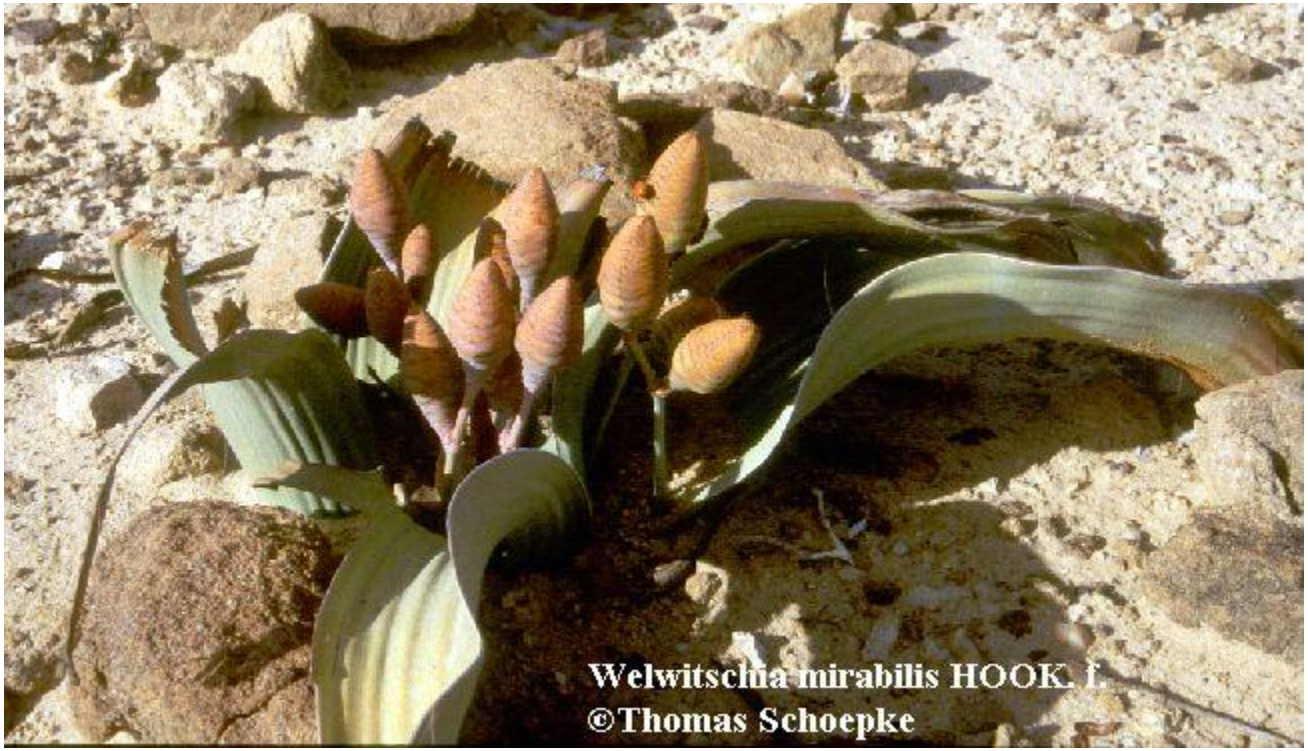

David Webb
Midvein
Carpel
Petiole

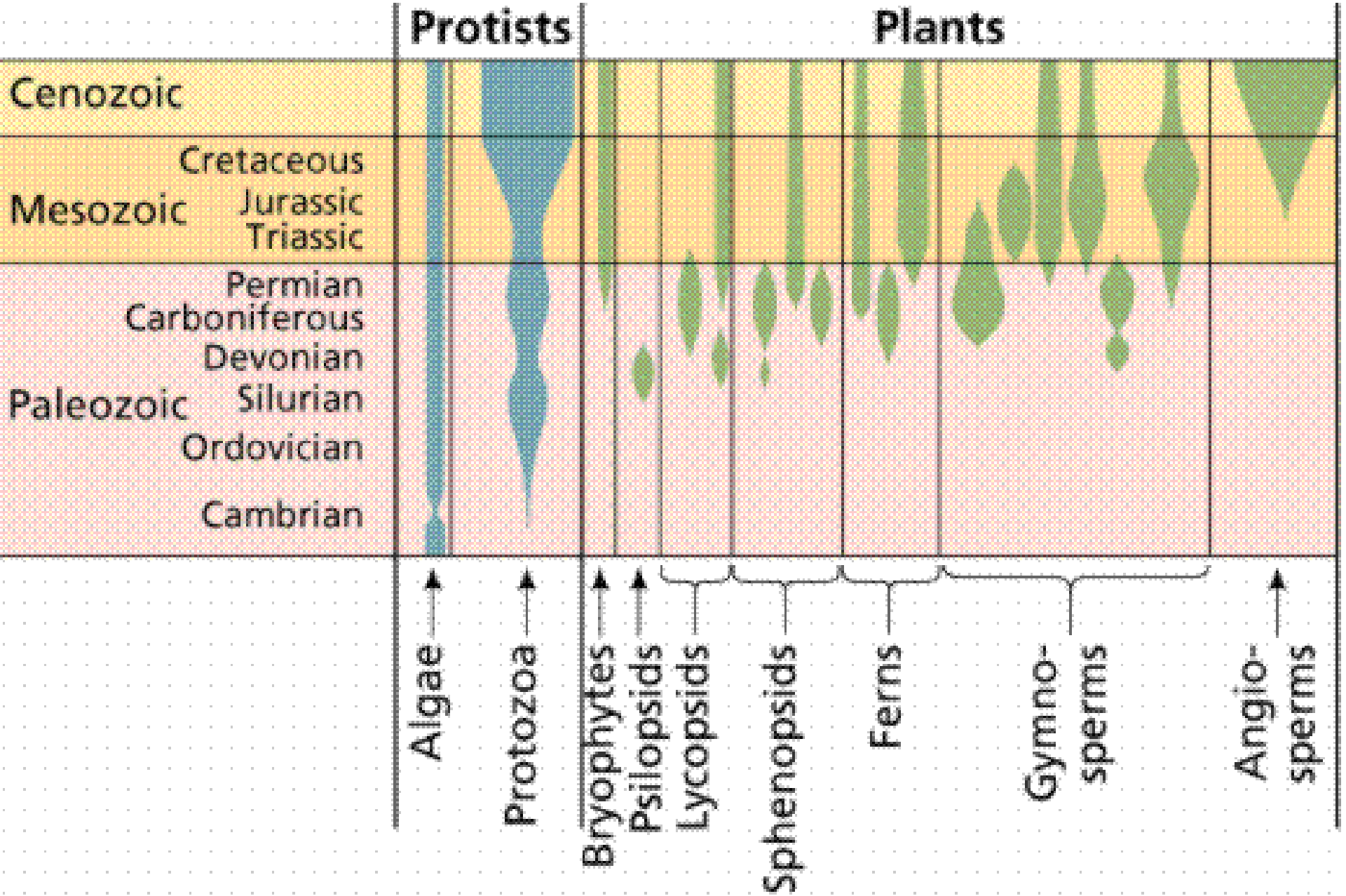


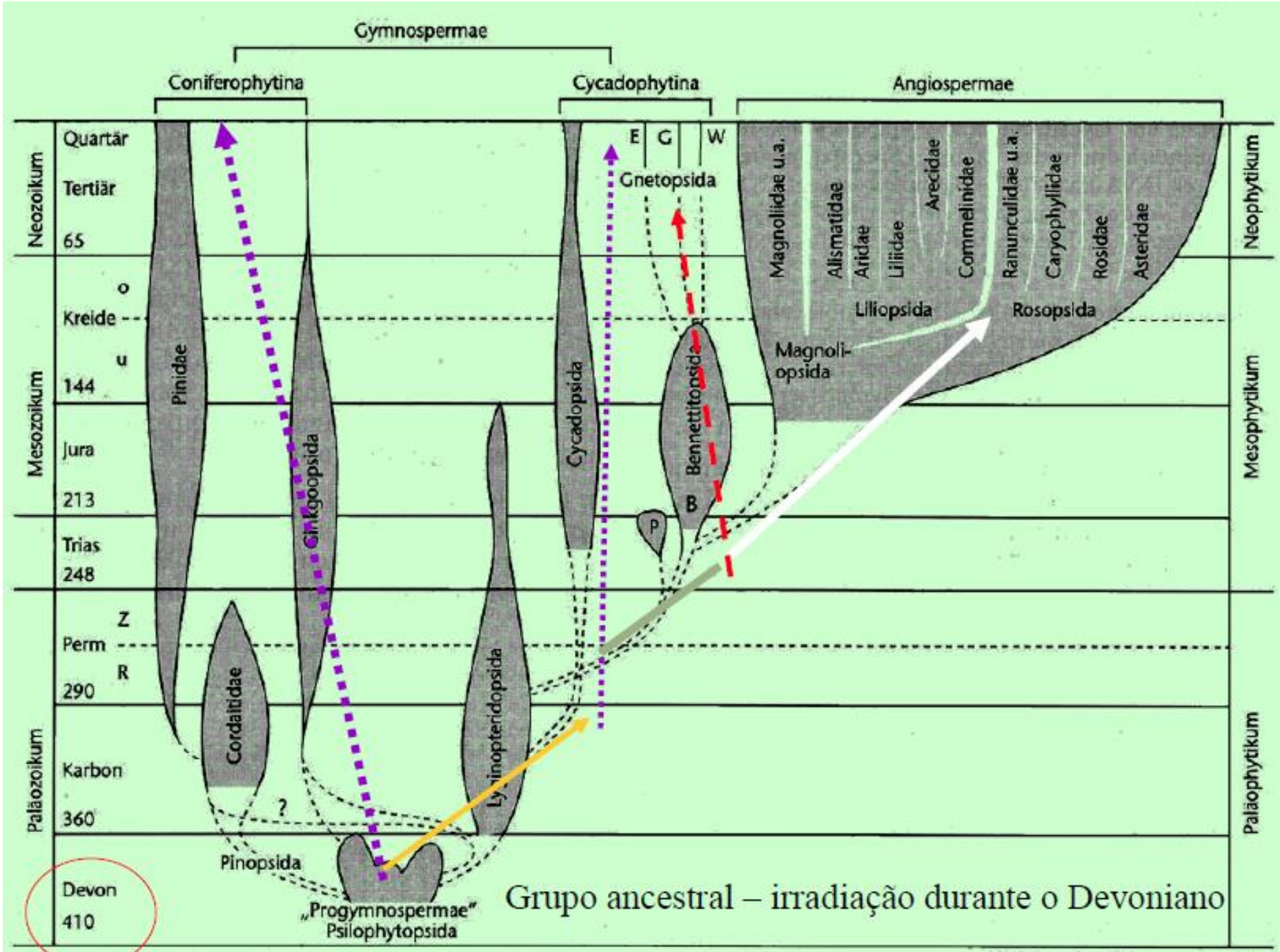

Style
Stigma
Ovules
Ovary Wall
Pericarp
Carpel
David Webb

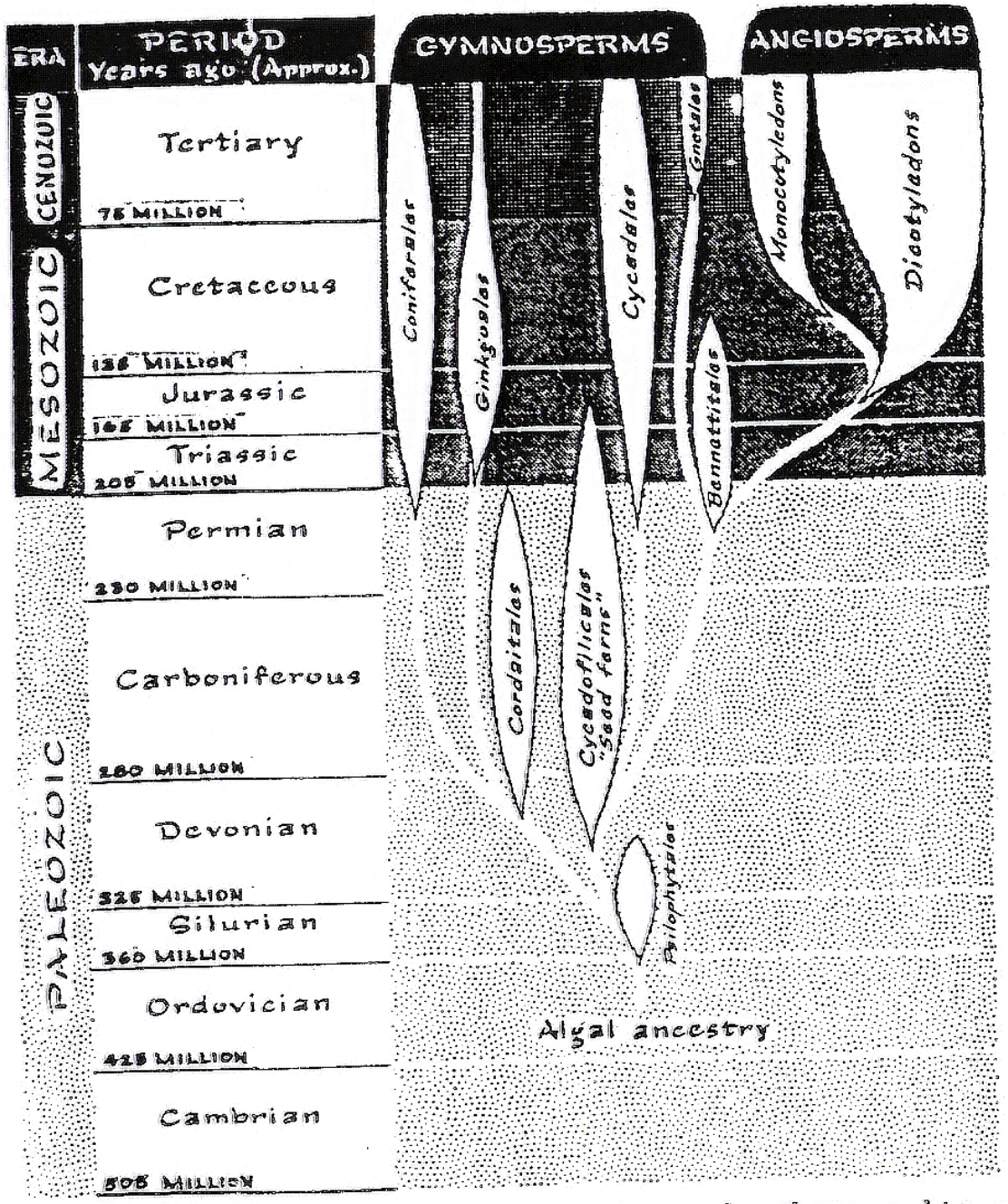
“Gimnospermas” é um grupo taxonômico?



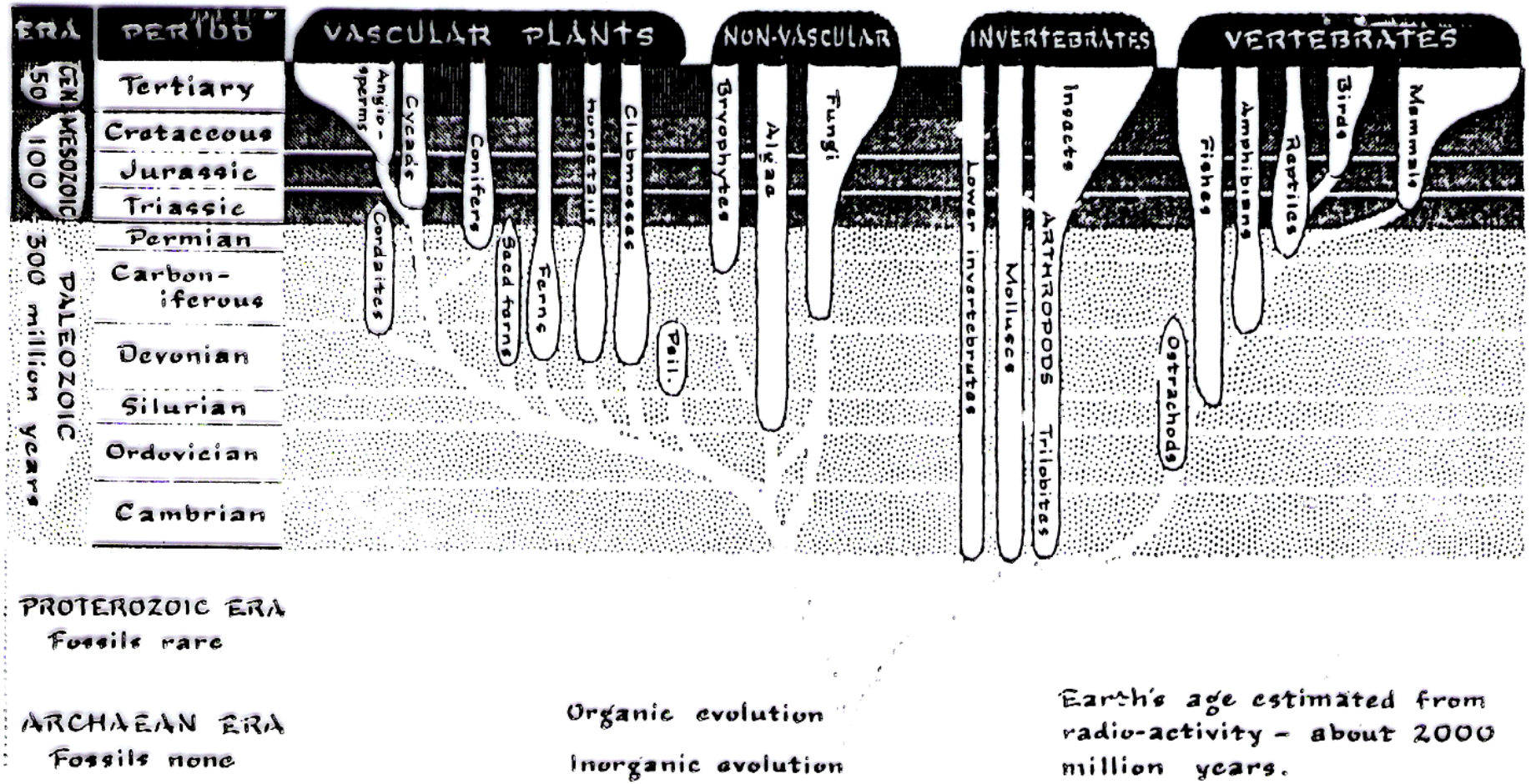

Welwitschia mirabilis HOOK. f.
©Thomas Schoepke


Protists
Plants
Cenozoic
Mesozoic
Cretaceous
Jurassic
Triassic
Paleozoic
Permian
Carboniferous
Devonian
Silurian
Ordovician
Cambrian
Algae
Protozoa
Bryophytes
Psilopsids
Lycopsids
Sphenopsids
Ferns
Gymno-
sperms
Angio-
sperms

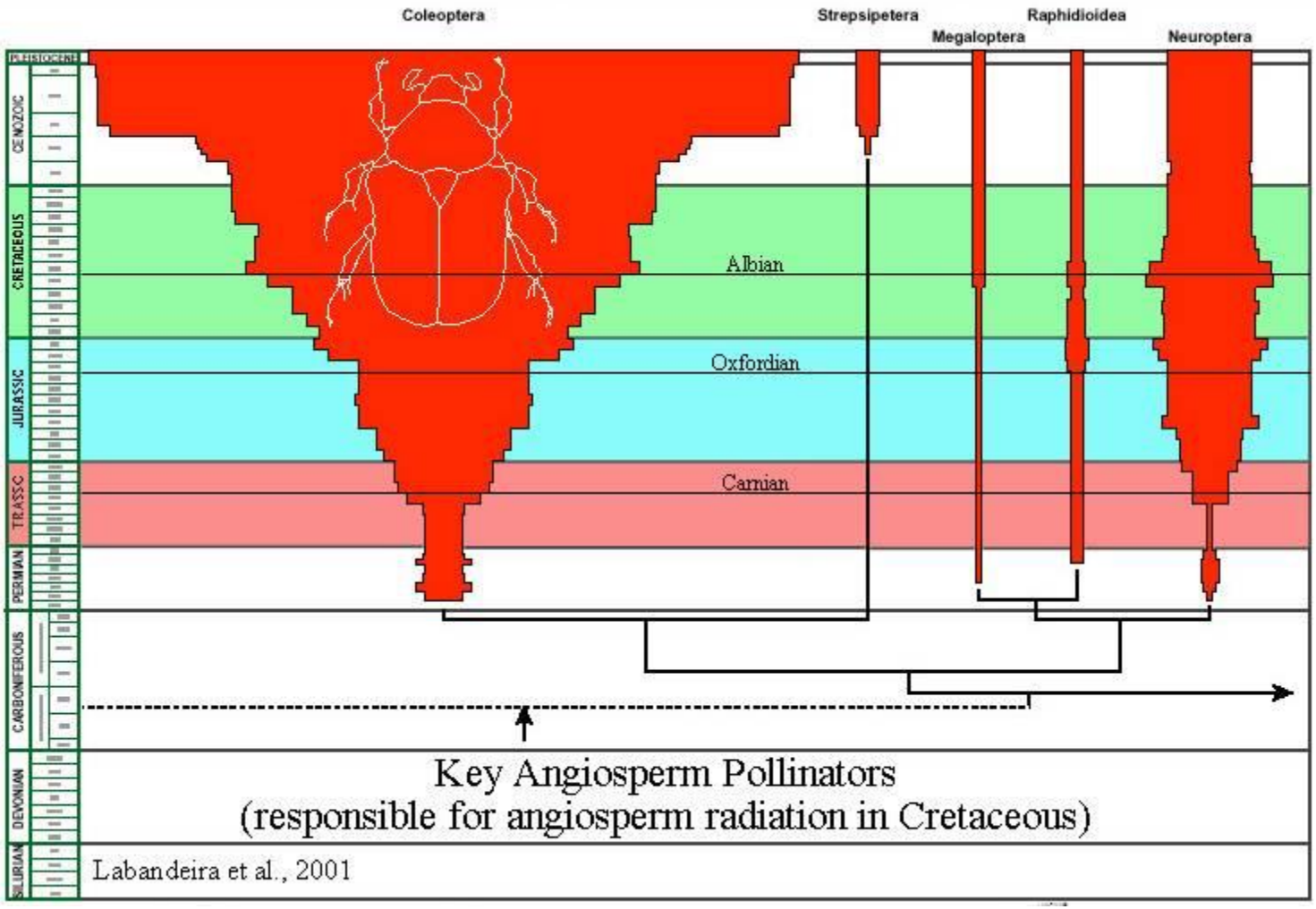

Gymnospermae
Coniferophytina
Cycadophytina
Angiospermae
Neozoikum
Quartär
Tertiär
65
Mesozoikum
o
Kreide
u
144
Jura
213
Trias
248
Paläozoikum
Z
Perm
R
290
Karbon
360
Devon
410
Pinidae
Ginkgoopsida
Cordaitidae
?
Pinopsida
„Progymnospermae"
Psilophytopsida
Lyginopteridopsida
Cycadopsida
E
G
W
Gnetopsida
Bennettitopsida
B
P
Magnolidae u.a.
Alismatidae
Aridae
Liliidae
Arecidae
Commelinidae
Ranunculidae u.a.
Caryophyllidae
Rosidae
Asteridae
Liliopsida
Rosopsida
Magnoli-
opsida
Neophytikum
Mesophytikum
Paläophytikum
Grupo ancestral – irradiação durante o Devoniano

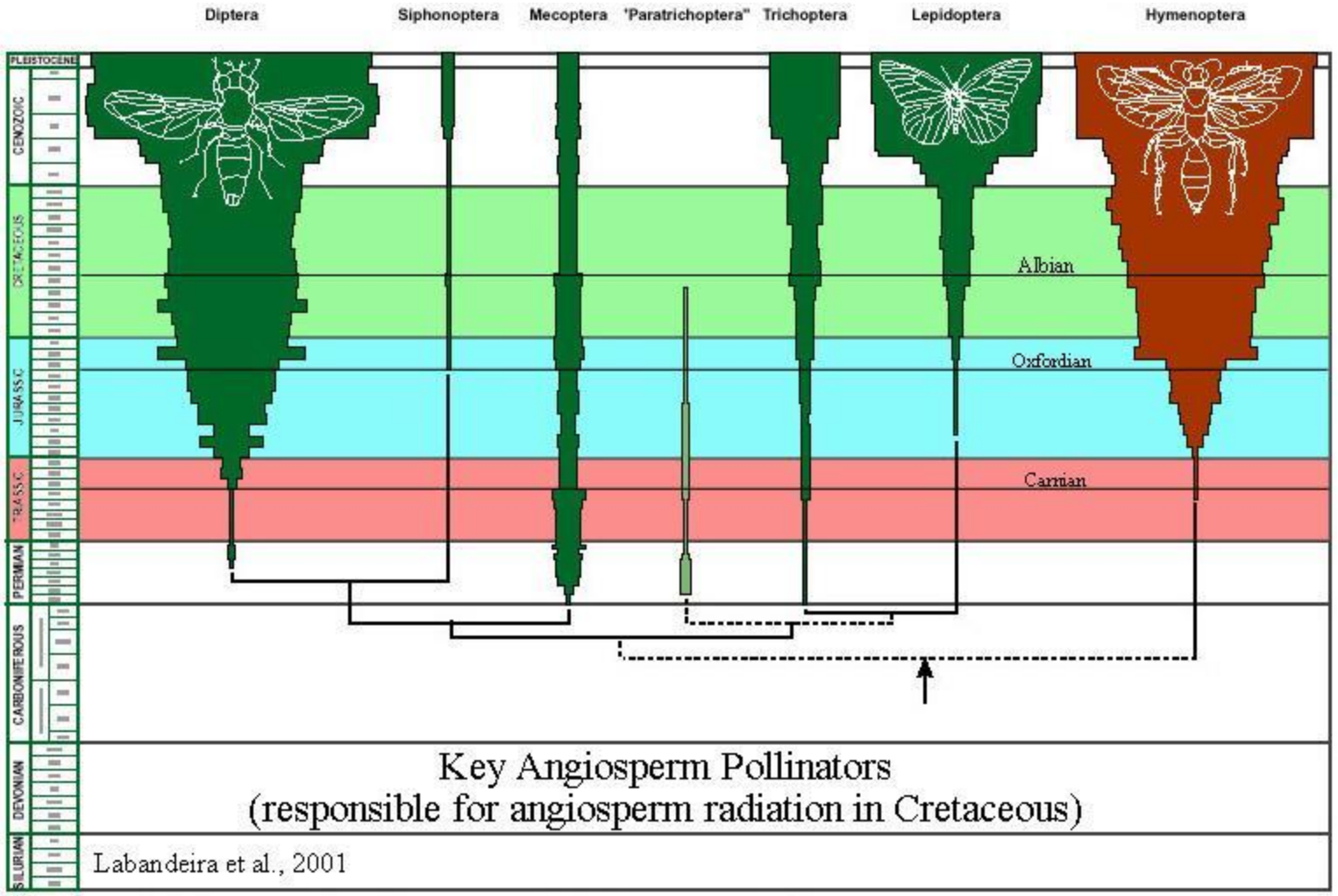


108 More detailed chart of possible relationships and evolutionary history of the seed plants.



107 Diagram illustrating the dominance of plant and animal groups in the geologic periods and their relationships. [Modified from Alfred Gunderson in Brooklyn Botanic Garden Leaflets, Ser. 18, No. 4 (1930); used by permission.]


Coleoptera
Strepsipetera
Megaloptera
Raphidioidea
Neuroptera
PLEISTOCENE
CENOZOIC
CRETACEOUS
JURASSIC
TRASSIC
PERMIAN
CARBONIFEROUS
DEVONIAN
SILURIAN
Albian
Oxfordian
Carnian
Key Angiosperm Pollinators
(responsible for angiosperm radiation in Cretaceous)
Labandeira et al., 2001


Diptera
Siphonoptera
Mecoptera
"Paratrichoptera"
Trichoptera
Lepidoptera
Hymenoptera
PLEISTOCENE
CENOZOIC
CRETACEOUS
JURASSIC
TRIASSIC
PERMIAN
CARBONIFEROUS
DEVONIAN
SILURIAN
Albian
Oxfordian
Carnian
Key Angiosperm Pollinators
(responsible for angiosperm radiation in Cretaceous)
Labandeira et al., 2001

Present
Angiospermae
Cenozoic
Mesozoic
Palaeozoic
Tertiary
Cretaceous
Jurassic
Triassic
Permian
Carbon-
iferous
Devonian
Silurian
Lycopsida
Sphenopsida
Filicopsida
Ginkgopsida
Coniferopsida
Cycadales
Monocotyledones
Dicotyledones
Pentoxylales
Gnetopsida
Bennettitales
Pteridospermopsida
Cordaitopsida
Progymnospermopsida
Psilophytopsida

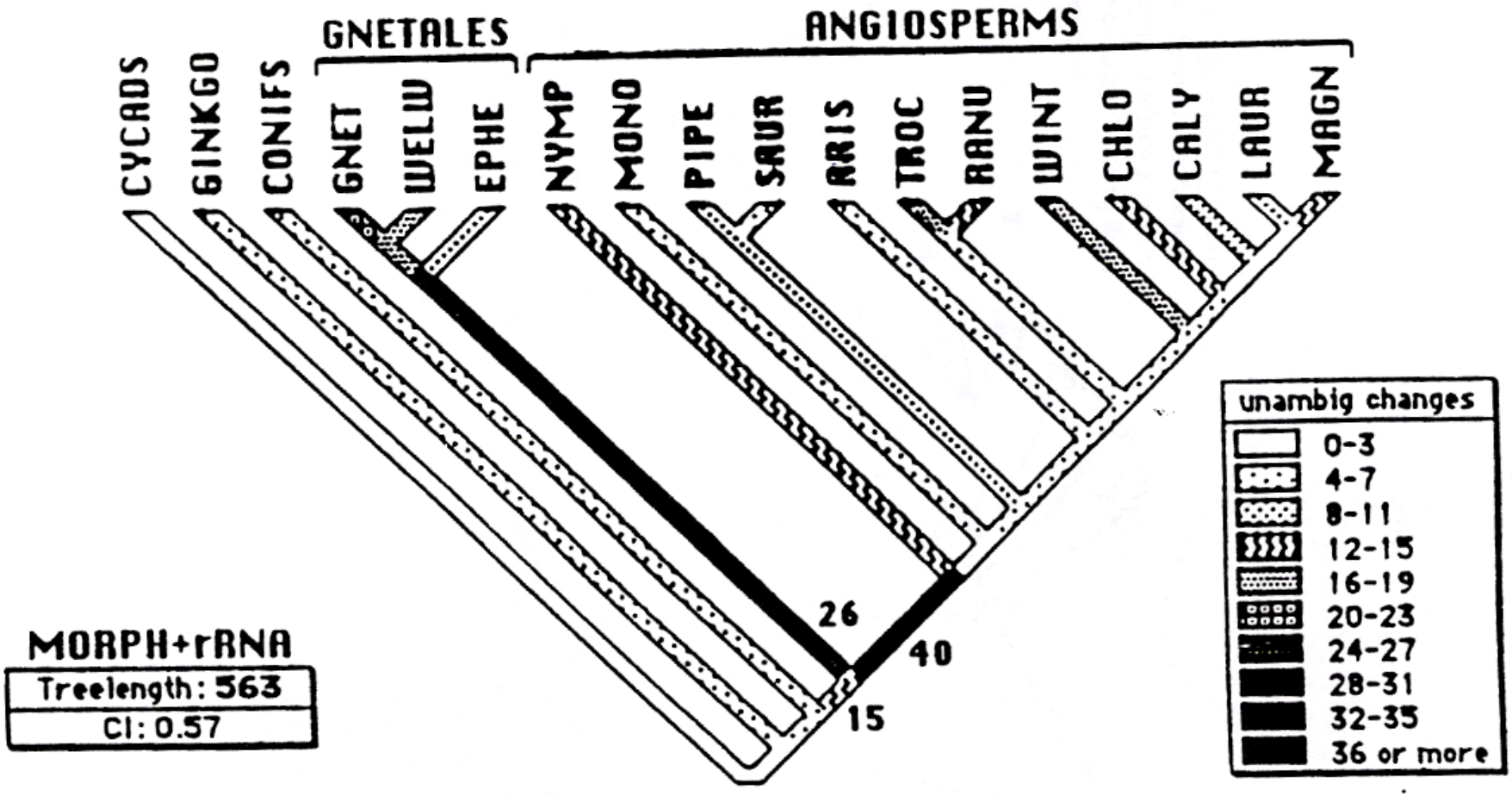


FIGURE 16. Single most parsimonious tree found in analysis of the combined morphological and rRNA data set, showing the number of unambiguous changes supporting each clade. Abbreviations as in Figure 8.

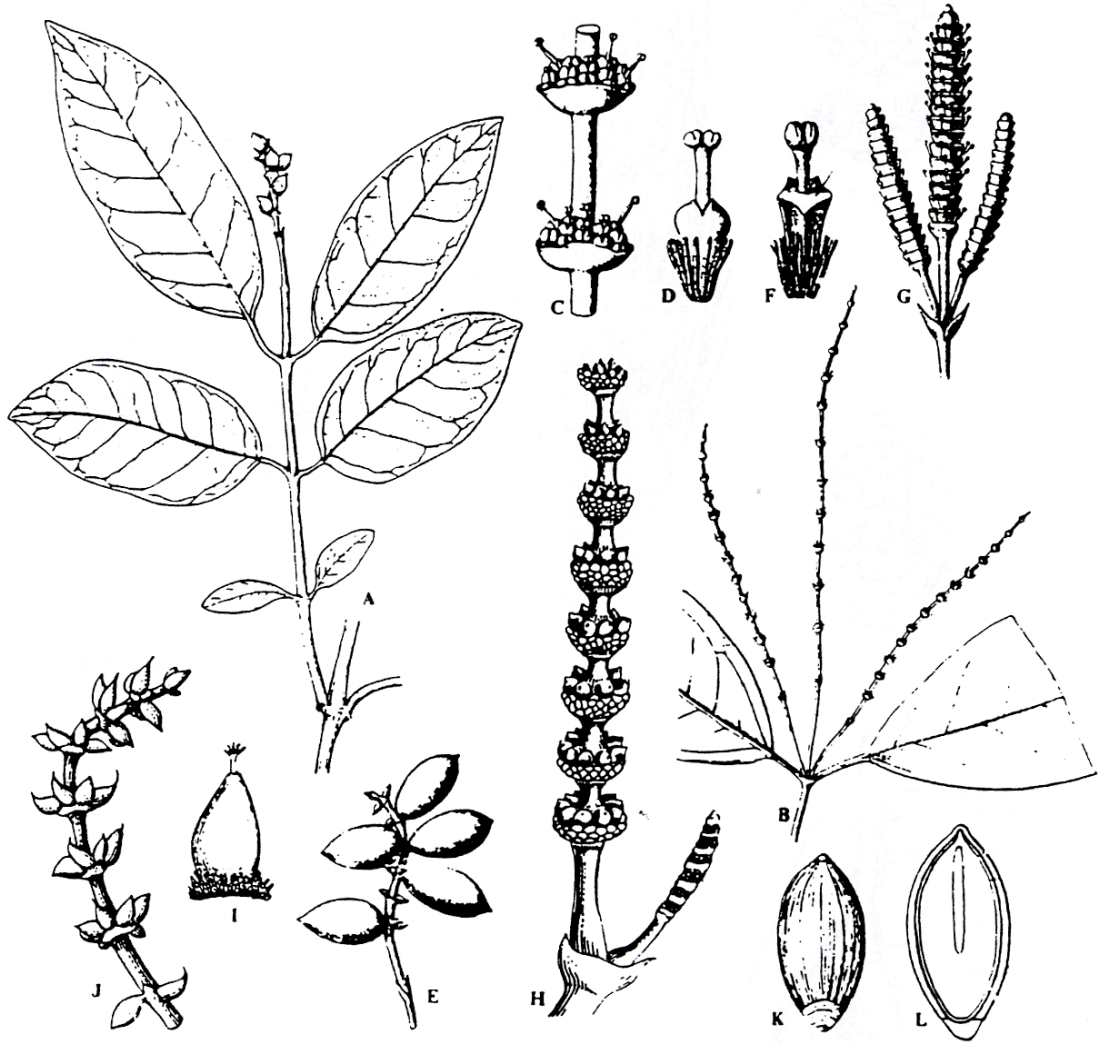
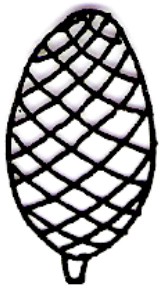


Fig. 10. Gnetophyta . Gnetaceae.

A-L. Gnetaceae. A *Gnetum indicum*. fruiting branch. B-E *Gnetum africanum*. B Male spikes. C Part of male spike. D Male flower. E Fruiting spike. F, G *Gnetum latifolium*. F Male flower. G Male spikes. H-L *Gnetum gnemon*. H Female spike with rudimentary male flowers. I Female flower. J Female spike. K Seed. L Seed in longitudinal section (A from Foster and Gifford 1959; B-E from Engler 1908; F, G from Wettstein 1935; H from Bold et al. 1980; I, K, L from Velenovsky 1910; J from Markgraf 1926)

ENGLER (1964)

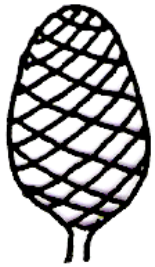


estróbilo ♂





inflorescência com flores aclamídeas ♂



estróbilo ♀





inflorescência com flores aclamídeas ♀

Hipótese Pseudantial

Planta “primitiva” para Engler

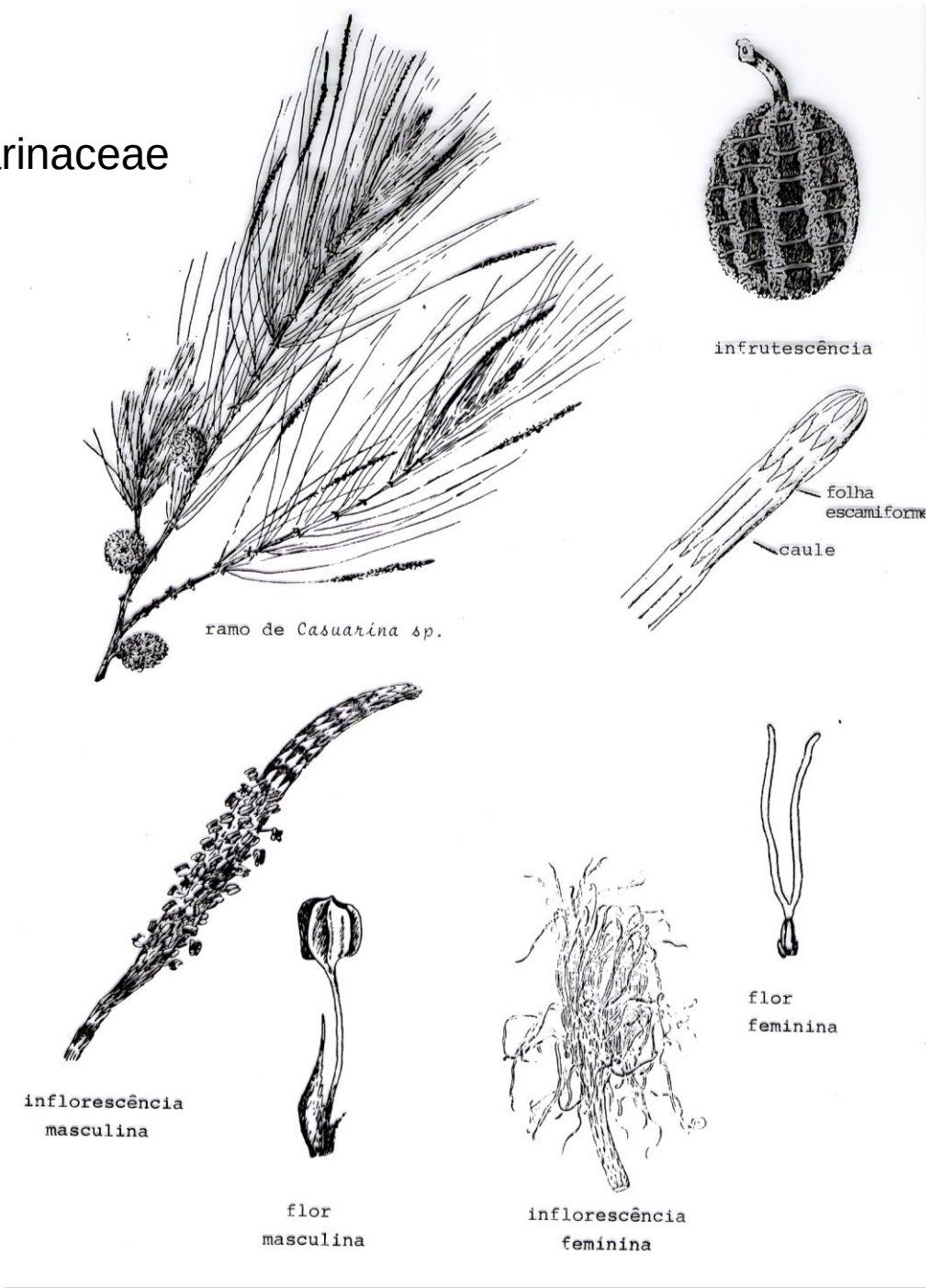


- Aclamídeas
- Unissexuadas
- Polinizadas pelo vento





Família Casuarinaceae

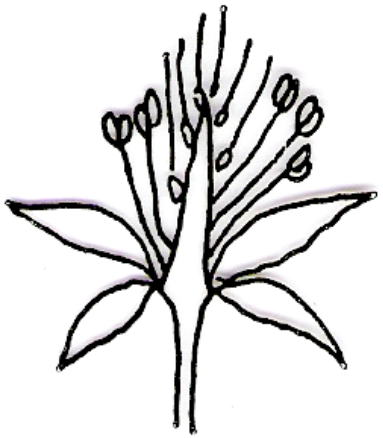


CRONQUIST (1981)



estróbilo ♀

(fóssil)



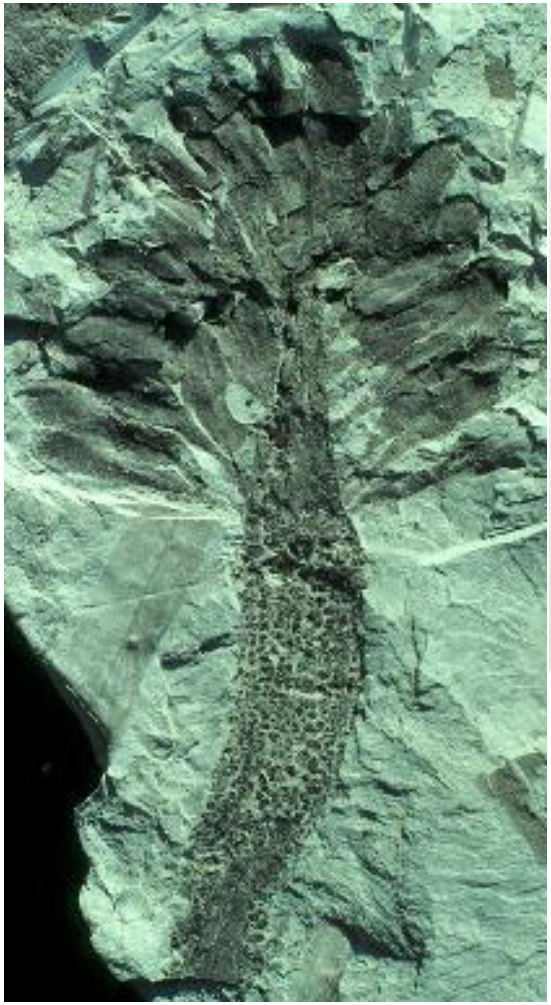
flor diclamídea ♀

Hipótese Euantial ou Antostrobilar

Planta primitiva para Cronquist



Archaeanthus

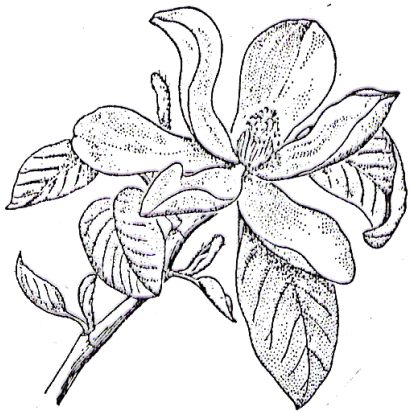




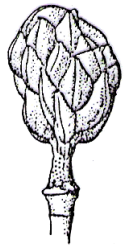




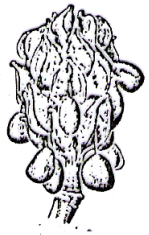
FAMÍLIA MAGNOLIACEAE



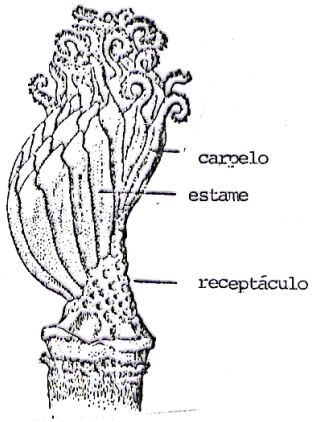
ramo de *Magnolia sp.*

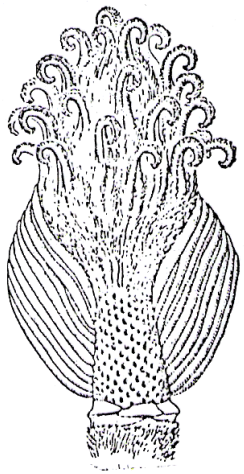


fruto
jovem

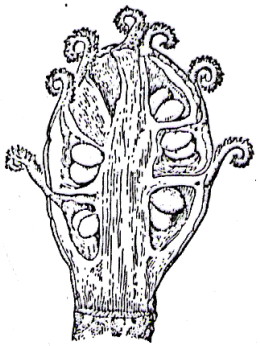


fruto
maduro

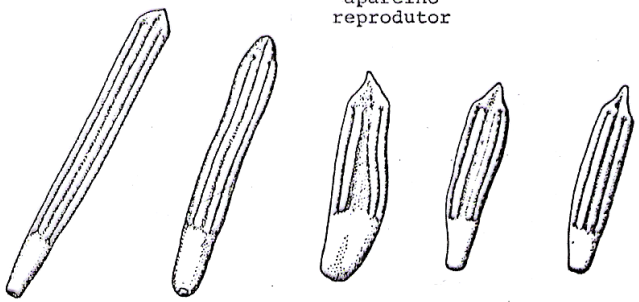




aparelho
reprodutor

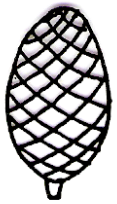


gineceu (CL)



estames laminares

ENGLER (1964)

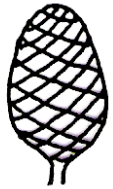


estróbilo ♂





inflorescência com flores aclamídeas ♂



estróbilo ♀





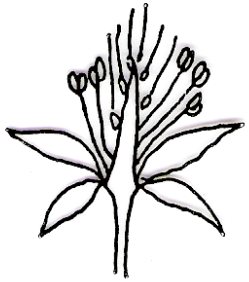
inflorescência com flores aclamídeas ♀

CRONQUIST (1981)



estróbilo ♀
(fóssil)





flor diclamídea ♀

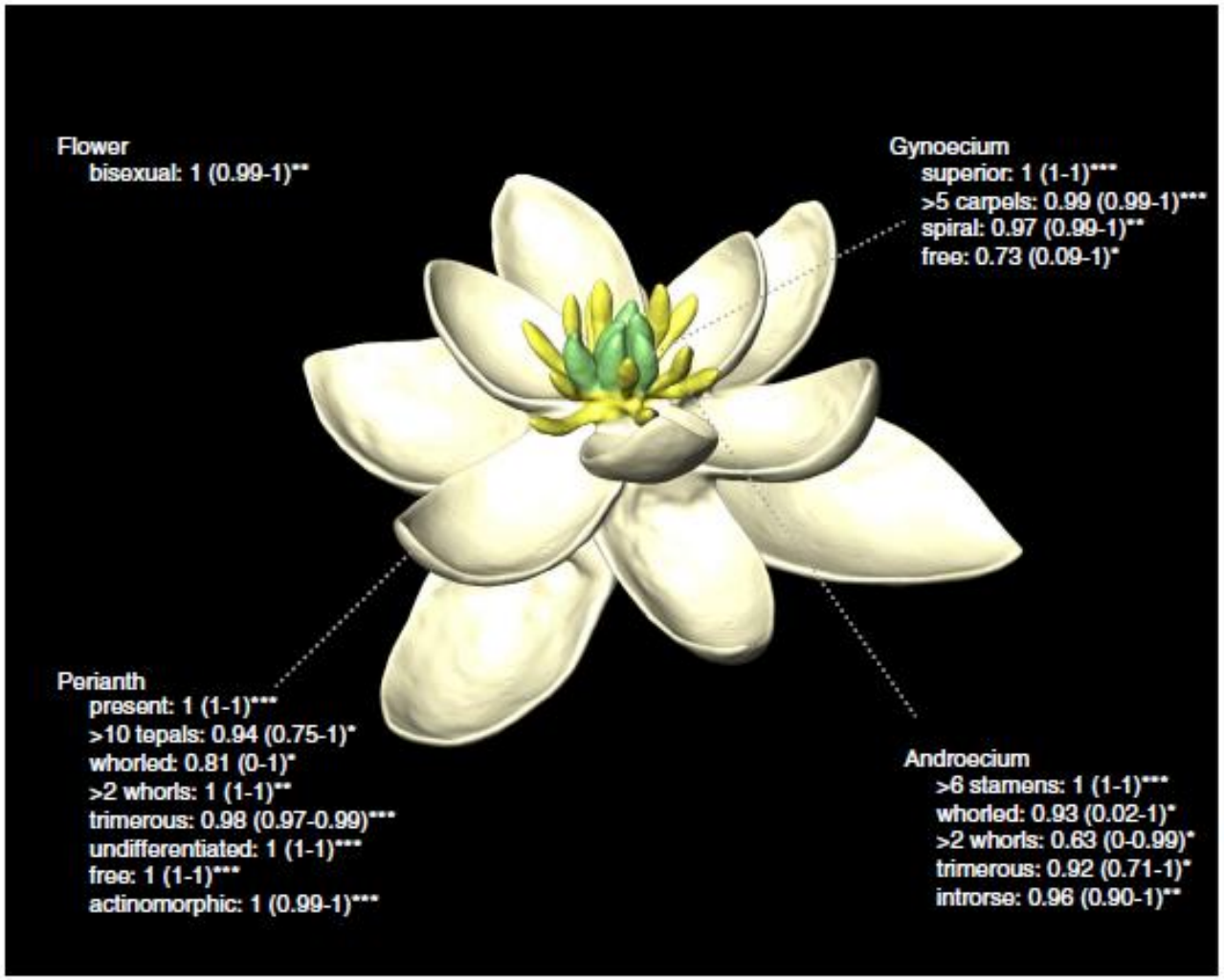
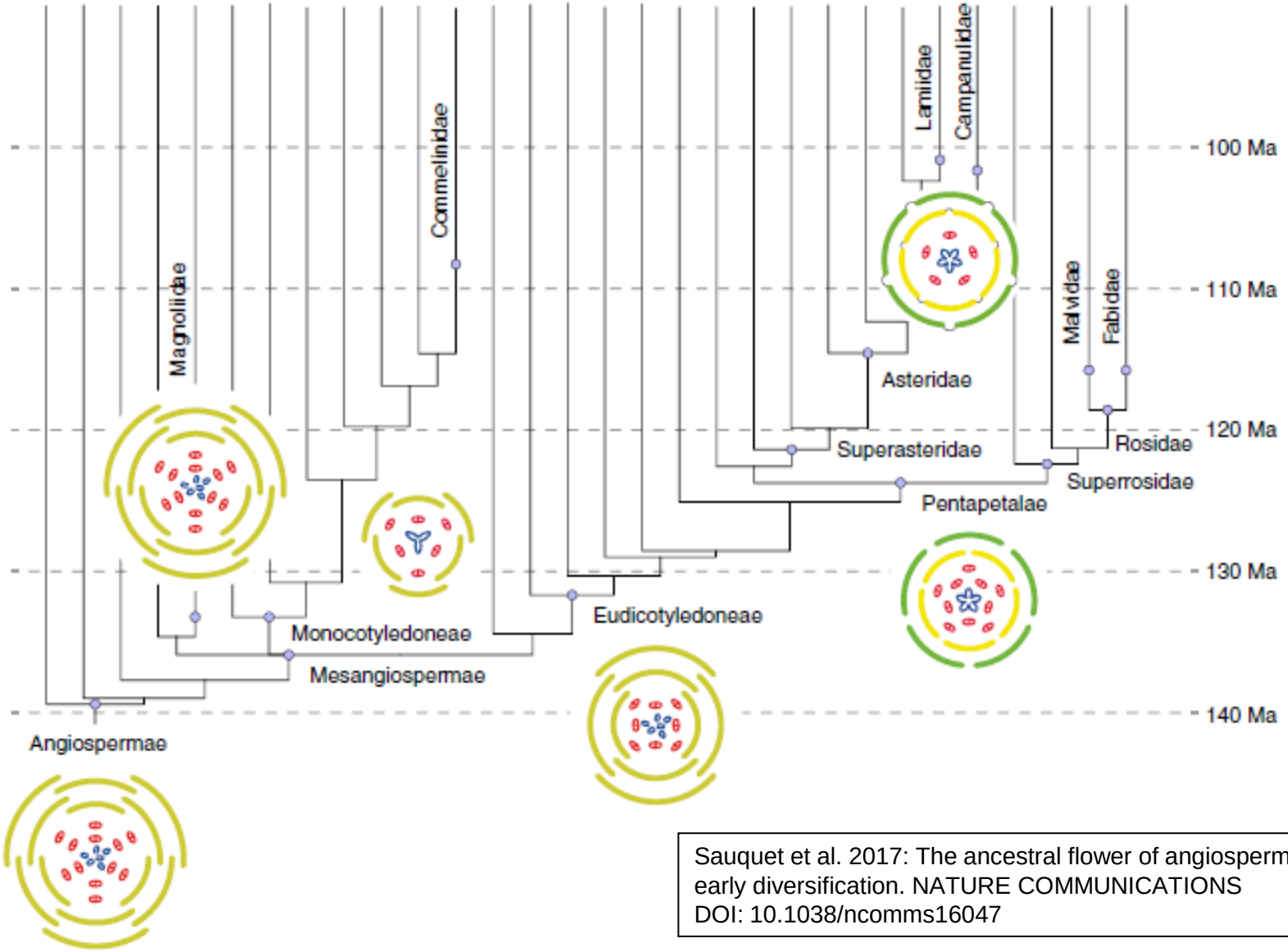


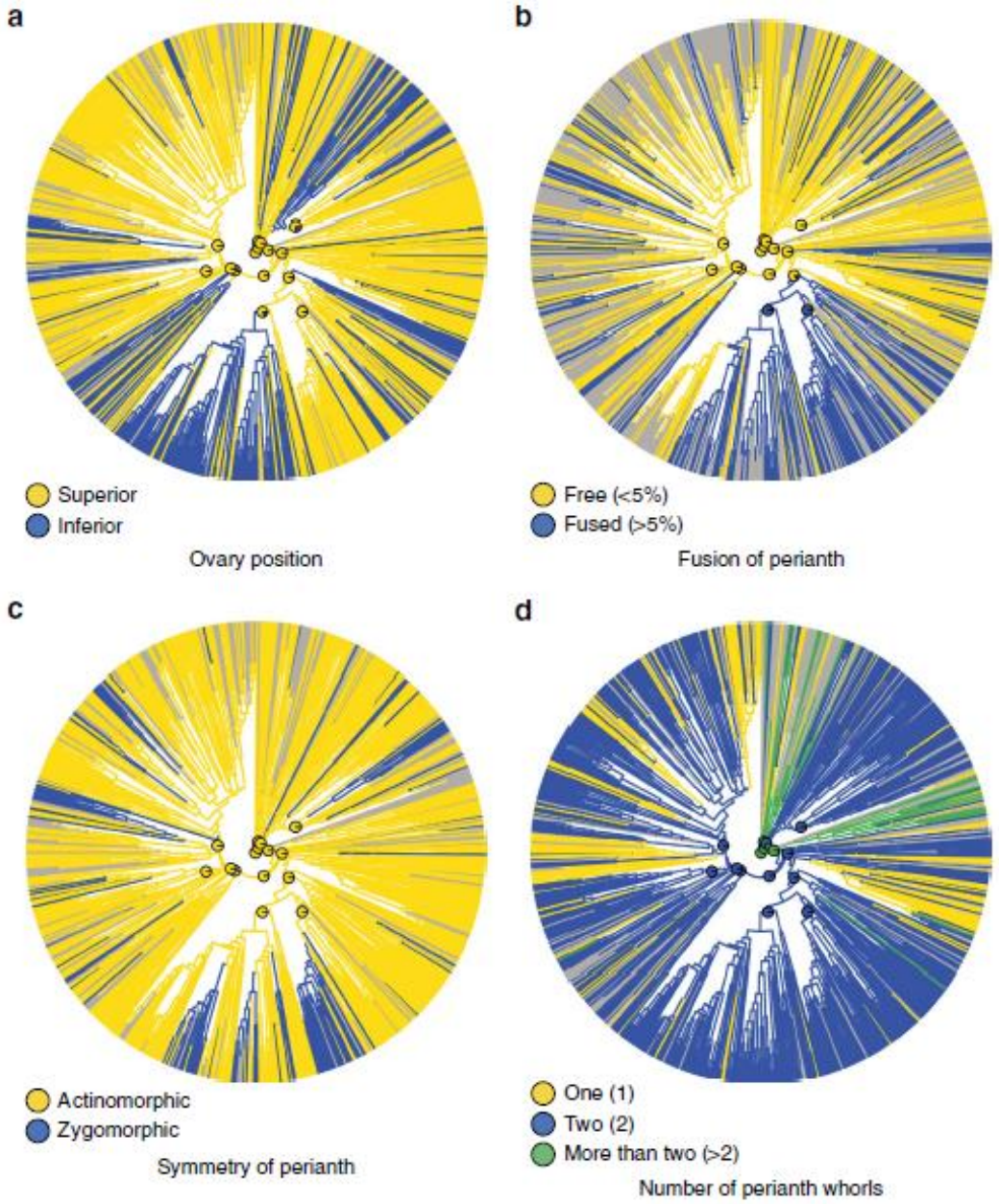
Figure 1 | Three-dimensional model of the ancestral flower reconstructed from our analyses. Here we provide the states with highest mean posterior probability and their associated credibility intervals from the reversible-jump Bayesian analysis of the C series of trees, which takes into account all forms of uncertainty (parameters, tree, branch times, model). States marked with three asterisks (***) indicate high confidence and consistency across methods of reconstruction (for example, perianth present, undifferentiated and actinomorphic). Other states need to be interpreted with caution as their reconstruction

Sauquet et al. 2017: The ancestral flower of angiosperms and its early diversification. NATURE COMMUNICATIONS
DOI: 10.1038/ncomms16047



Sauquet et al. 2017: The ancestral flower of angiosperms and its early diversification. NATURE COMMUNICATIONS
DOI: 10.1038/ncomms16047

Figure 4 | Simplified scenario for the earliest phase of floral diversification as inferred from our analyses. Each floral diagram summarizes the main features of our reconstructed ancestors for key nodes of the tree (for details, see Supplementary Discussion and Supplementary Figs 2–7). This figure only depicts the presumed first 40 million years of floral evolution, without exhaustively representing every new morphology that arose during that time. The



Sauquet et al. 2017: The ancestral flower of angiosperms and its early diversification. NATURE COMMUNICATIONS
DOI: 10.1038/ncomms16047

Figure 5 | Maximum likelihood ancestral state reconstructions of four representative floral characters. The pie charts at the centre of the figure indicate the proportional likelihoods for reconstructed ancestral states at 15 key nodes (here we optimized the characters on the maximum clade credibility tree from the C series; for complete results, see Supplementary Data 1 and Supplementary Data 14–23). Grey branches denote missing, inapplicable or polymorphic data. (**a**) Ovary position (character 102_B). (**b**) Fusion of perianth (character 204_A). (**c**) Symmetry of perianth (character 207_B). (**d**) Number of perianth whorls (character 231_A).

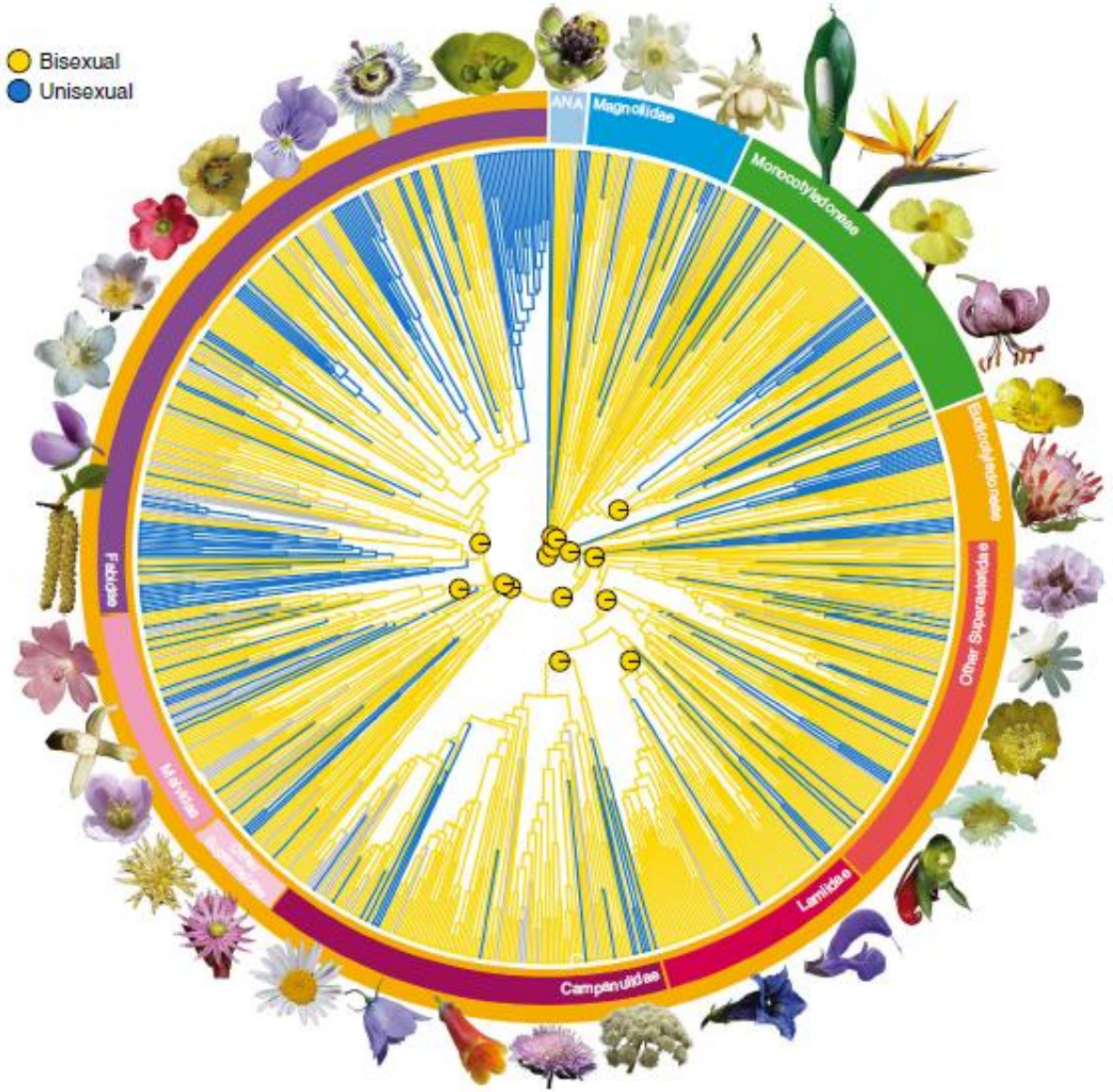
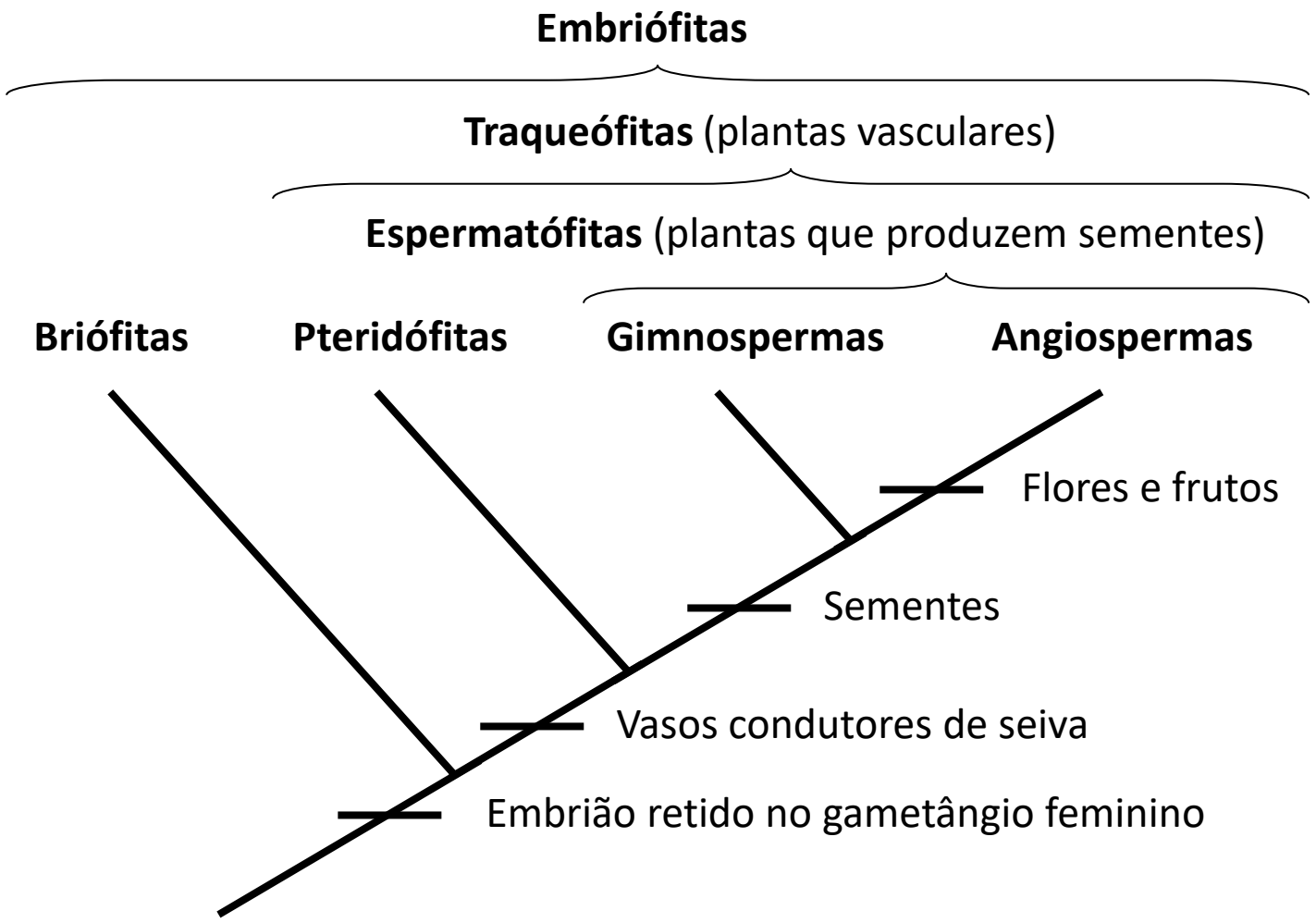


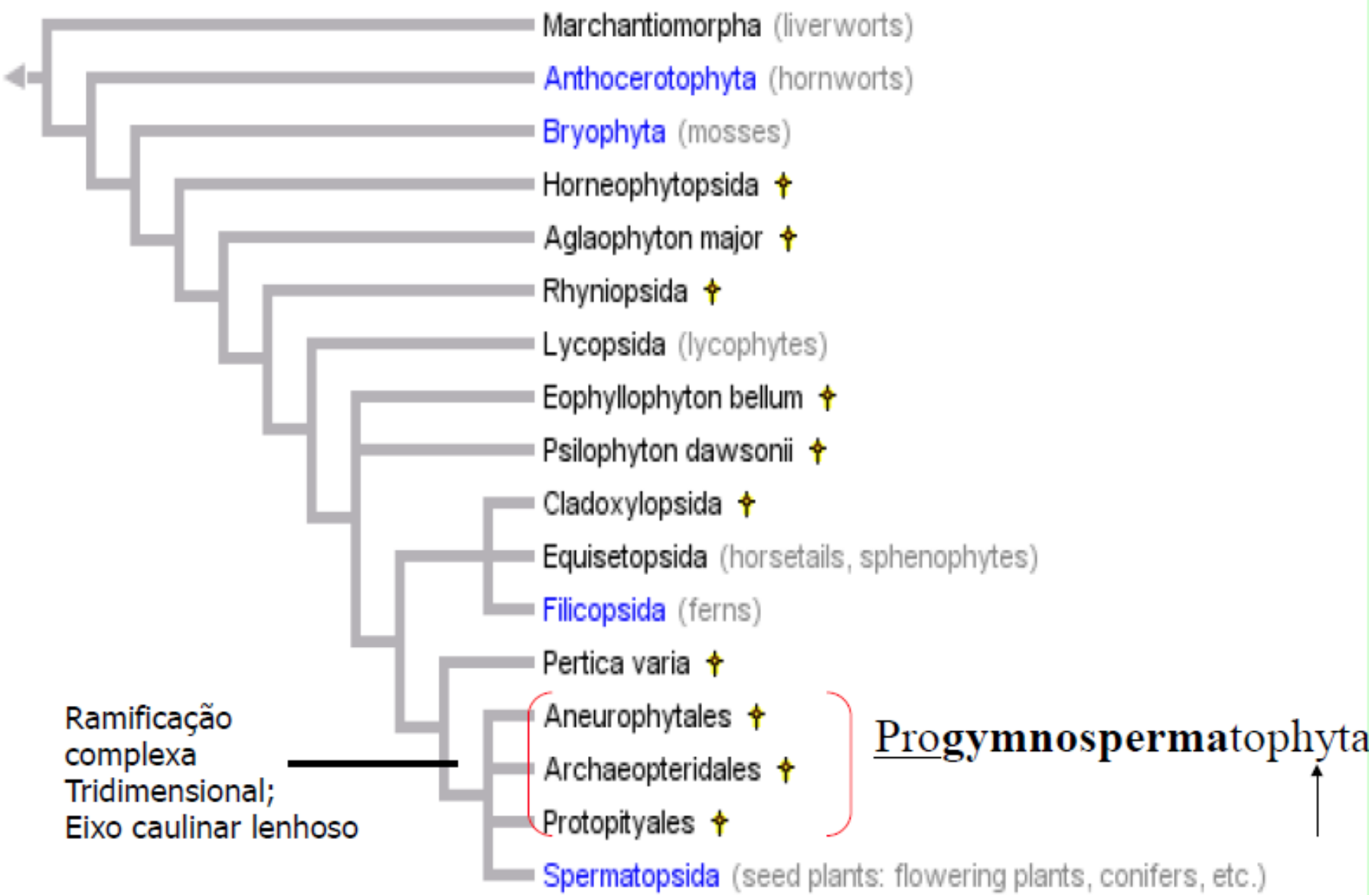
Figure 2 | Maximum likelihood ancestral state reconstruction of functional sex of flowers in angiosperms. Our results show that bisexual flowers are ancestral and that unisexual flowers evolved many times independently. The pie charts at the centre of the figure indicate the proportional likelihoods for

Sauquet et al. 2017: The ancestral flower of angiosperms and its early diversification. NATURE COMMUNICATIONS
DOI: 10.1038/ncomms16047


Embriófitas
Traqueófitas (plantas vasculares)
Espermatófitas (plantas que produzem sementes)
Briófitas
Pteridófitas
Gimnospermas
Angiospermas
Flores e frutos
Sementes
Vasos condutores de seiva
Embrião retido no gametângio feminino

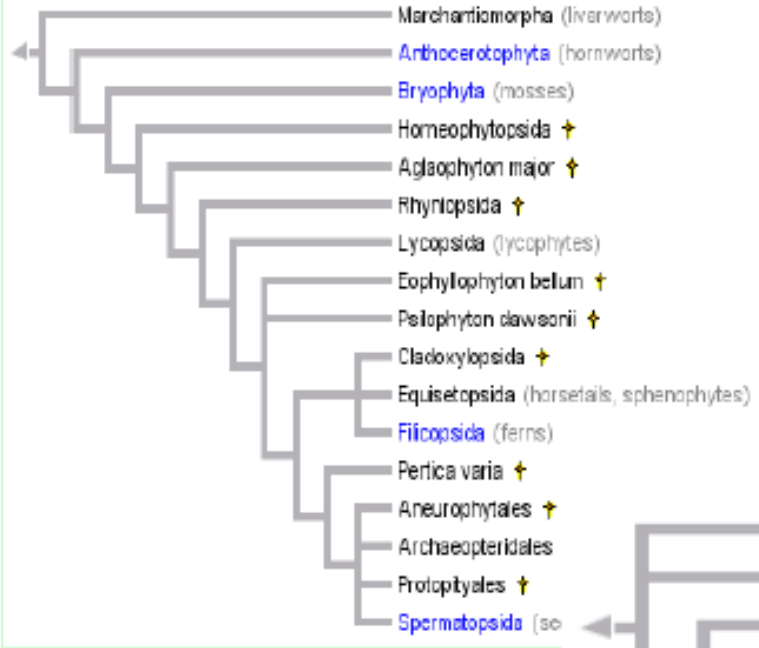
Espermatófitas

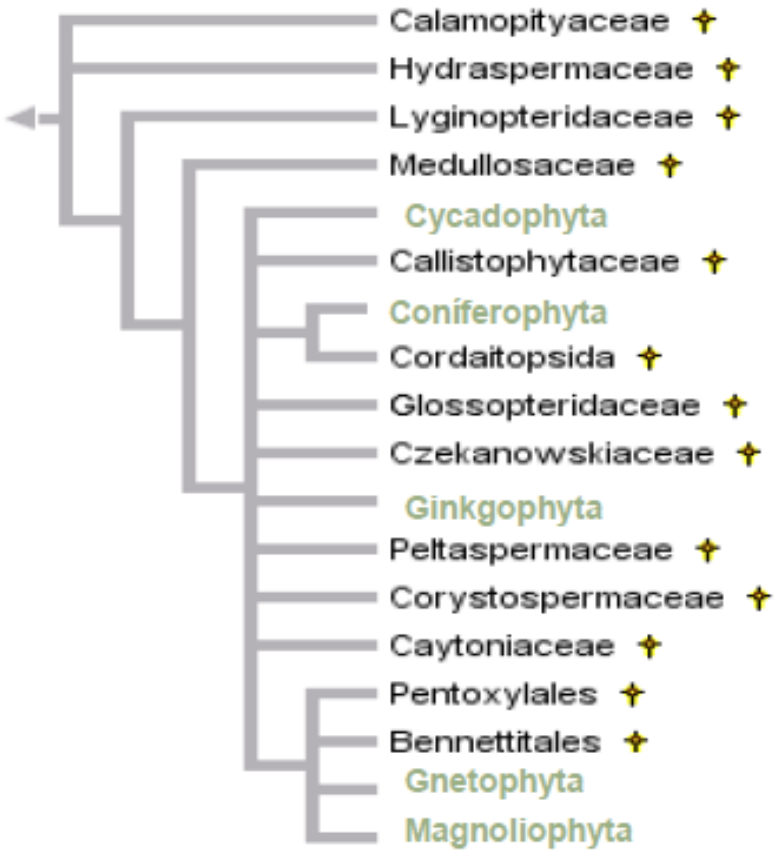
Peter Crane



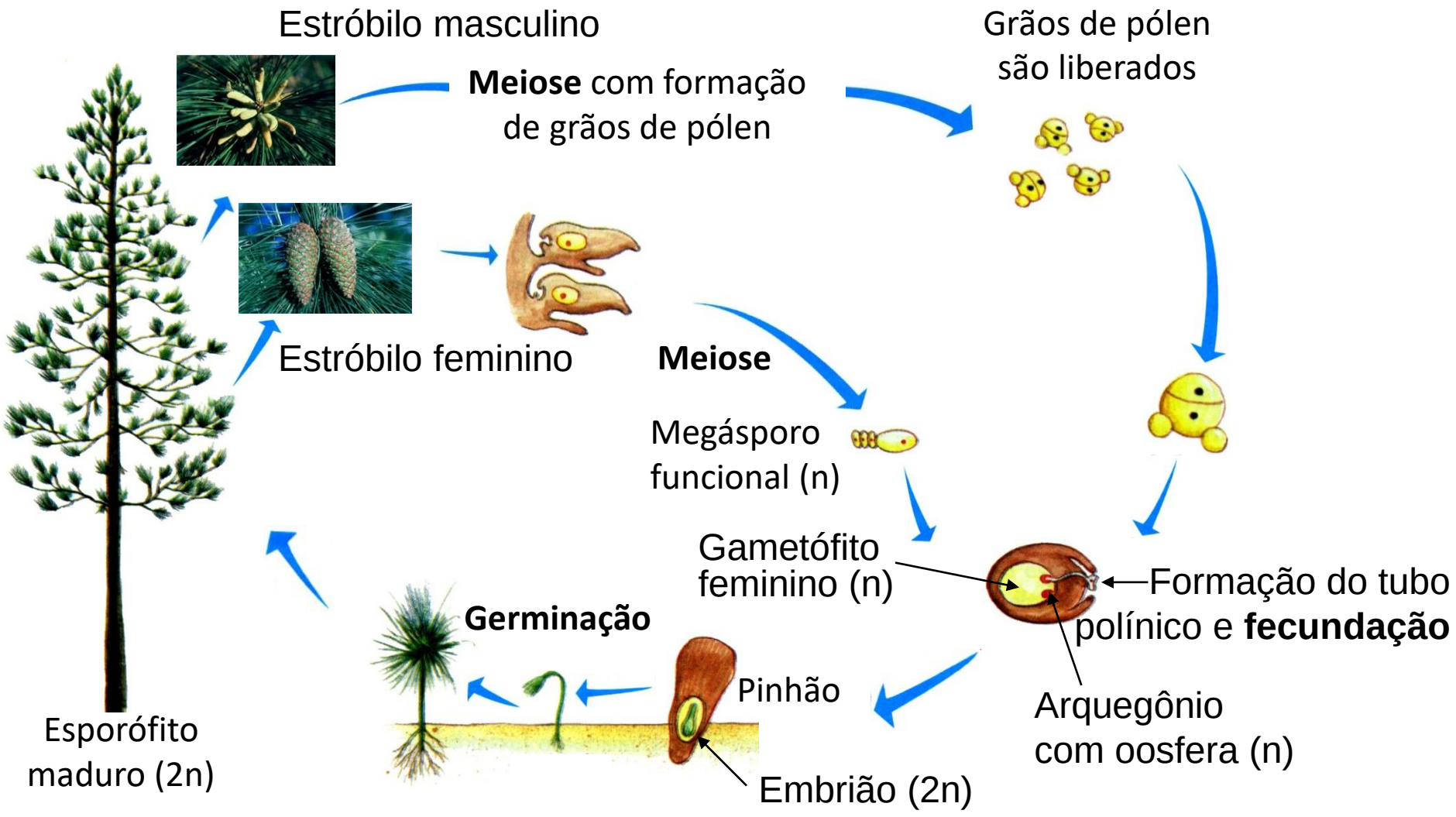
Espermatófitas

Peter Crane





Ciclo reprodutivo das gimnospermas



Grupos incluídos entre as Gimnospermas:

- 4 divisões (cada uma delas monofilética):
  - Cycadophyta
  - Ginkgophyta
  - Gnetophyta
  - Coniferophyta

CYCADOPHYTA

- Plantas semelhantes a palmeiras, com caule pouco ramificado e folhas pinadas ou pinatissectas concentradas no ápice do caule



CYCADOPHYTA

3 famílias
10 gêneros
Cerca de 130 espécies



Stangeriaceae



Zamiaceae



Cycadaceae



Estróbilo feminino de Cycas revoluta



Estróbilo masculino de Cycas revoluta

Cycadophyta no Brasil

- Zamiaceae – algumas espécies nativas.
- Cycadaceae – algumas espécies cultivadas como ornamentais.

Zamiaceae	Cycadaceae
•Megasporófilo com 2 óvulos. •Forma megastróbilos	•Megasporófilo com 2-8 óvulos •Não forma megastróbilos

- Micro = “masculino”
- Mega (ou macro) =“feminino”

Outras características das Cycadophyta

- Plantas dióicas.
- Microsporângios ocorrem na superfície inferior dos microsporófilos.
- O intervalo entre polinização e fertilização pode ser superior a 6 meses.
- Polinização:
  - síndrome – vento.
  - na realidade algumas espécies são polinizadas por insetos.

Cycadophyta – estruturas reprodutivas



Microstróbilo ou estróbilo masculino

microsporófilos

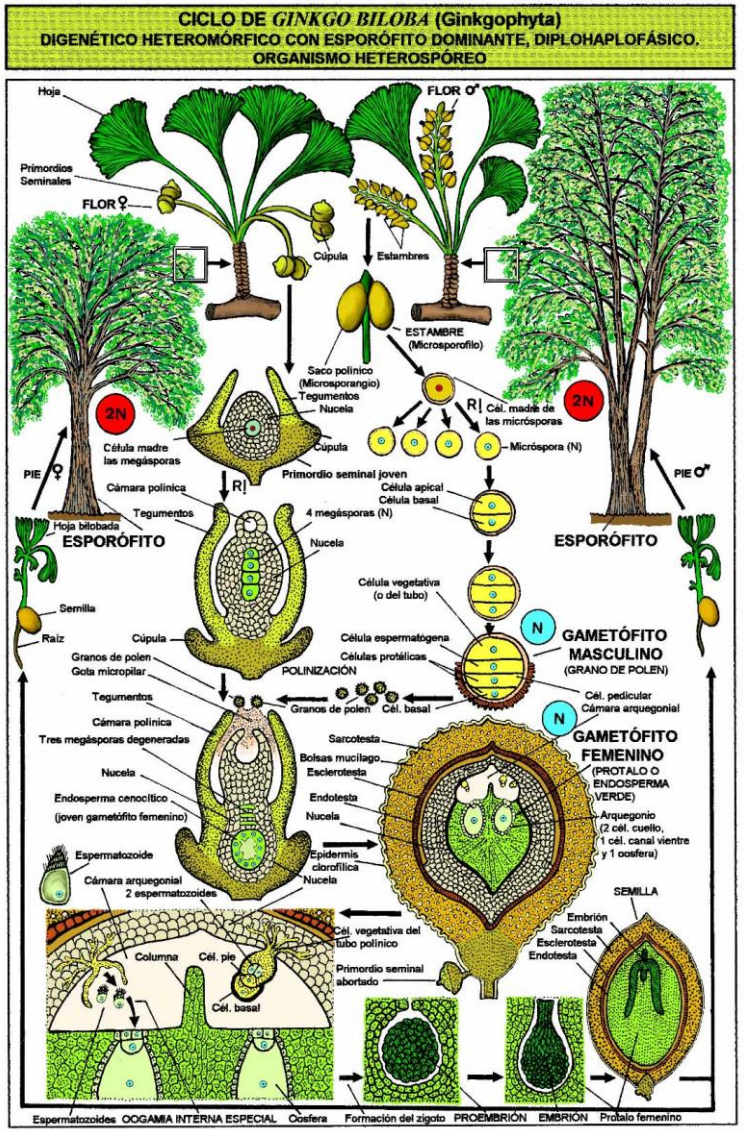




Estróbilo feminino (conjunto) com os megasporófilos (cada)

GINKGOPHYTA

- Divisão monoespecífica.
- *Ginko biloba*, a única espécie, provavelmente está extinta na natureza.



- Folhas flabeliformes
- Plantas dióicas








MONTVALE, N.J. 07645
METRIC 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15

Características de Ginkgophyta

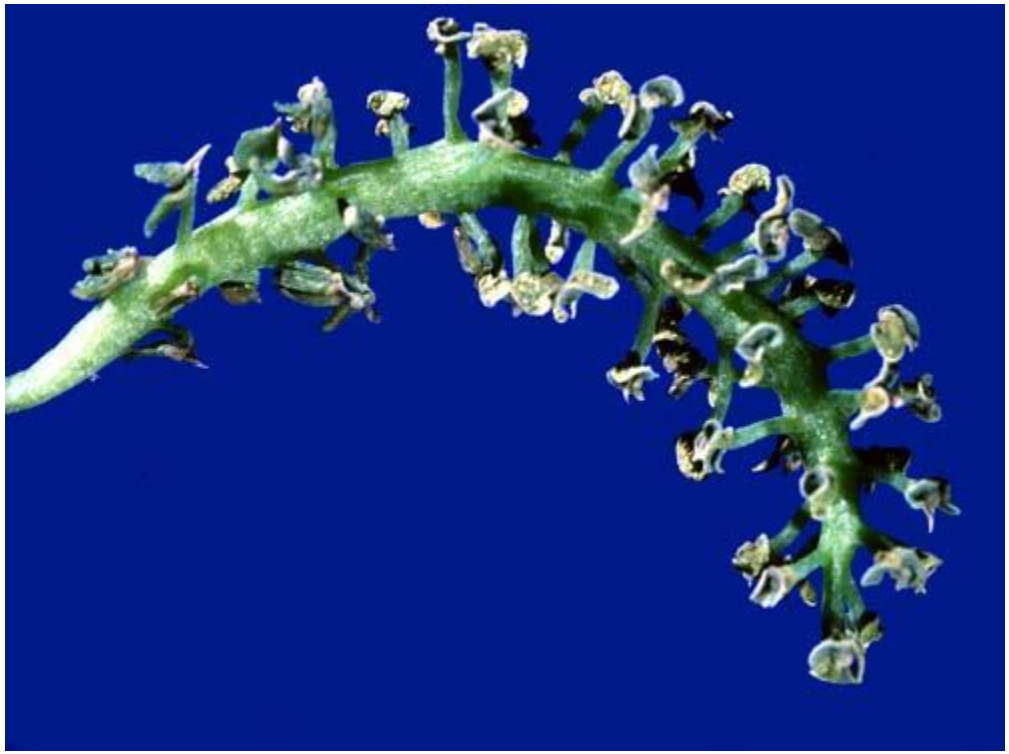
- Óvulos dispostos aos pares.



- Sementes carnosas, semelhantes a uma drupa.



•Pólen se desenvolve em agrupamentos de esporangióforos, semelhantes a estames



Gnetophyta

- Três famílias monogenéricas:

- Gnetaceae – *Gnetum*
- Ephedraceae – *Ephedra*
- Welwitschiaceae - *Welwitschia*

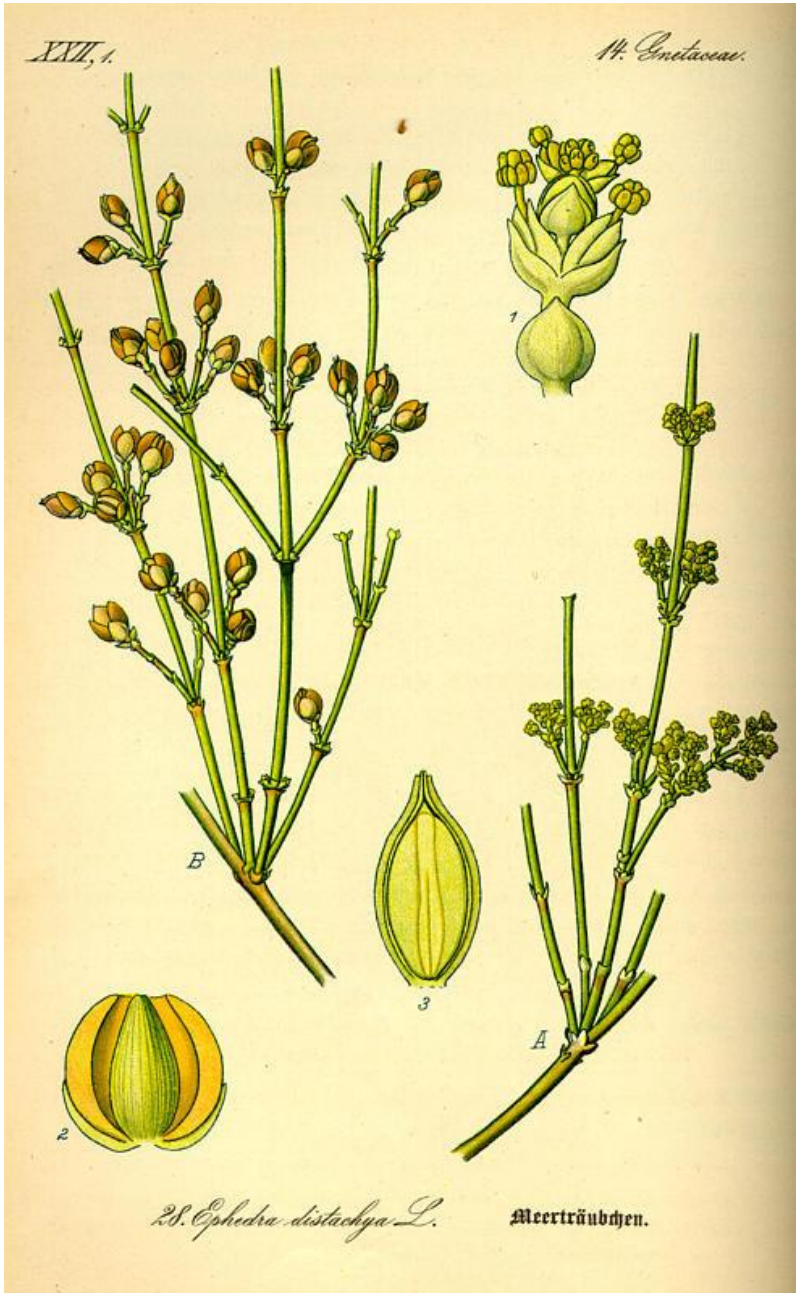
Ephedra



Ephedra

- Algumas espécies nativas no Sul do Brasil.
- Geralmente arbustos.
- Folhas opostas ou verticiladas, escamiformes




XXII, 1.
14. Gnetaceae.
1
B
3
A
2
28. Ephedra distachya L.
Meerträubchen.



Gnetum

- Diversas espécies nativas do Brasil, concentradas na Amazônia.
- Lianas lenhosas
- Folhas opostas



Welwitschia

- Nativa do deserto da Namíbia.
- Produz apenas duas folhas (divididas às vezes) durante toda a vida da planta.






© K. Kinach


© K. Knoch

CONIFEROPHYTA

- Principal grupo de Gimnospermas em número de espécies, distribuição e importância ecológica.
- Crescimento monopodial.
- Plantas monóicas ou dióicas.
- Polinização pelo vento.



CONIFEROPHYTA

- 7 famílias.
- 60-65 gêneros.
- cerca de 600 espécies

Coniferophyta



Pinaceae



Araucariaceae ***Araucaria angustifolia***



Podocarpaceae ***Podocarpus lambertii, P. sellowii***



Taxodiaceae =
Cupressaceae

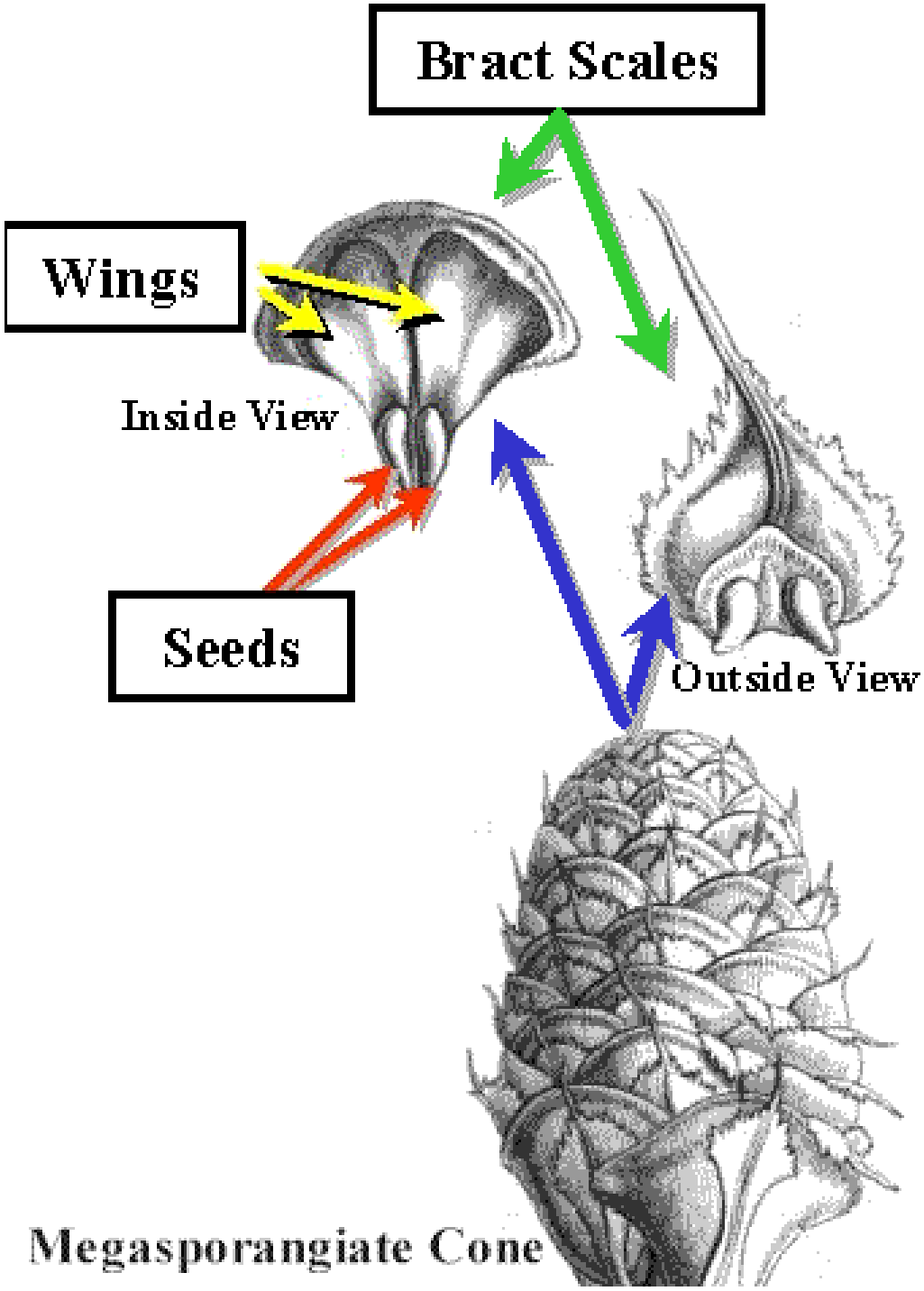


Cupressaceae

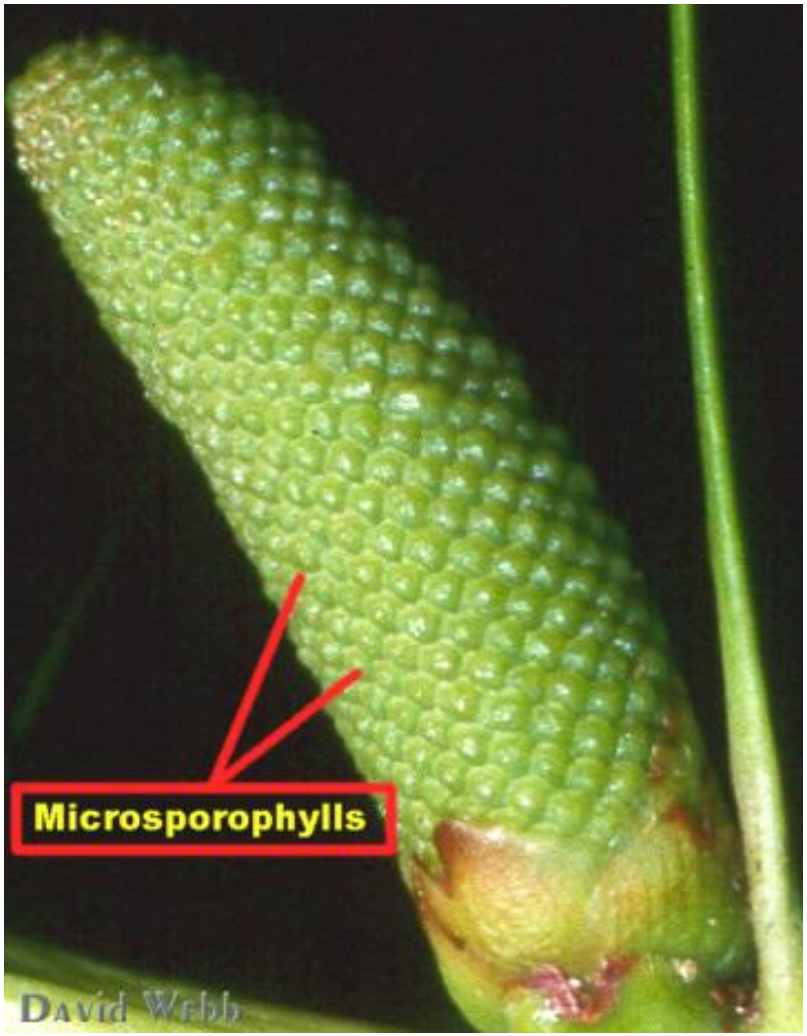
- Comumente os estróbilos se desenvolvem e formam uma estrutura lenhosa que protege as sementes, denominada CONE

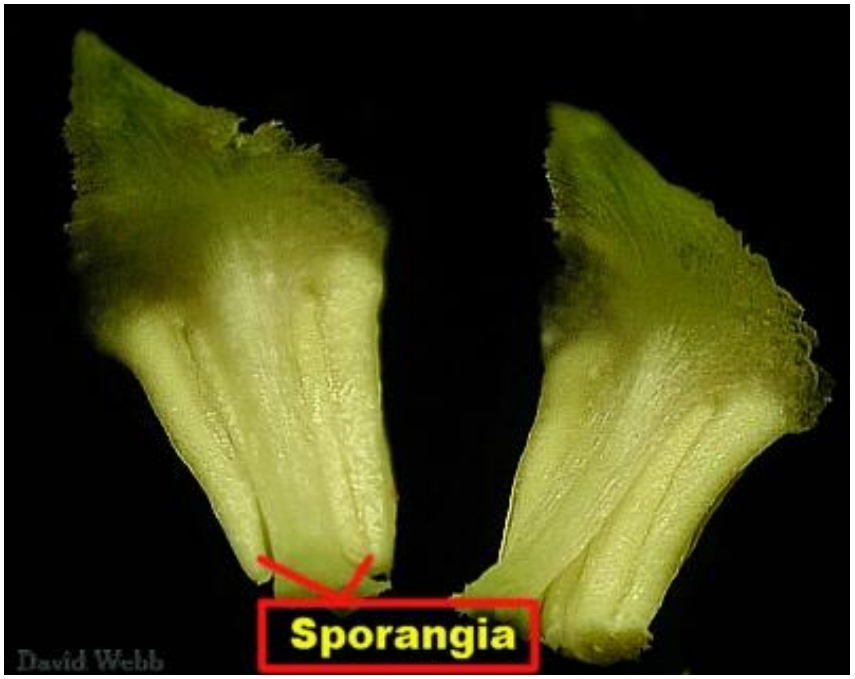





Bract Scales
Wings
Inside View
Seeds
Outside View
Megasporangiate Cone


David Webb
Ovule


Microsporophylls
David Webb


Sporangia
David Webb

Cupressaceae





Cupressaceae (exótica)





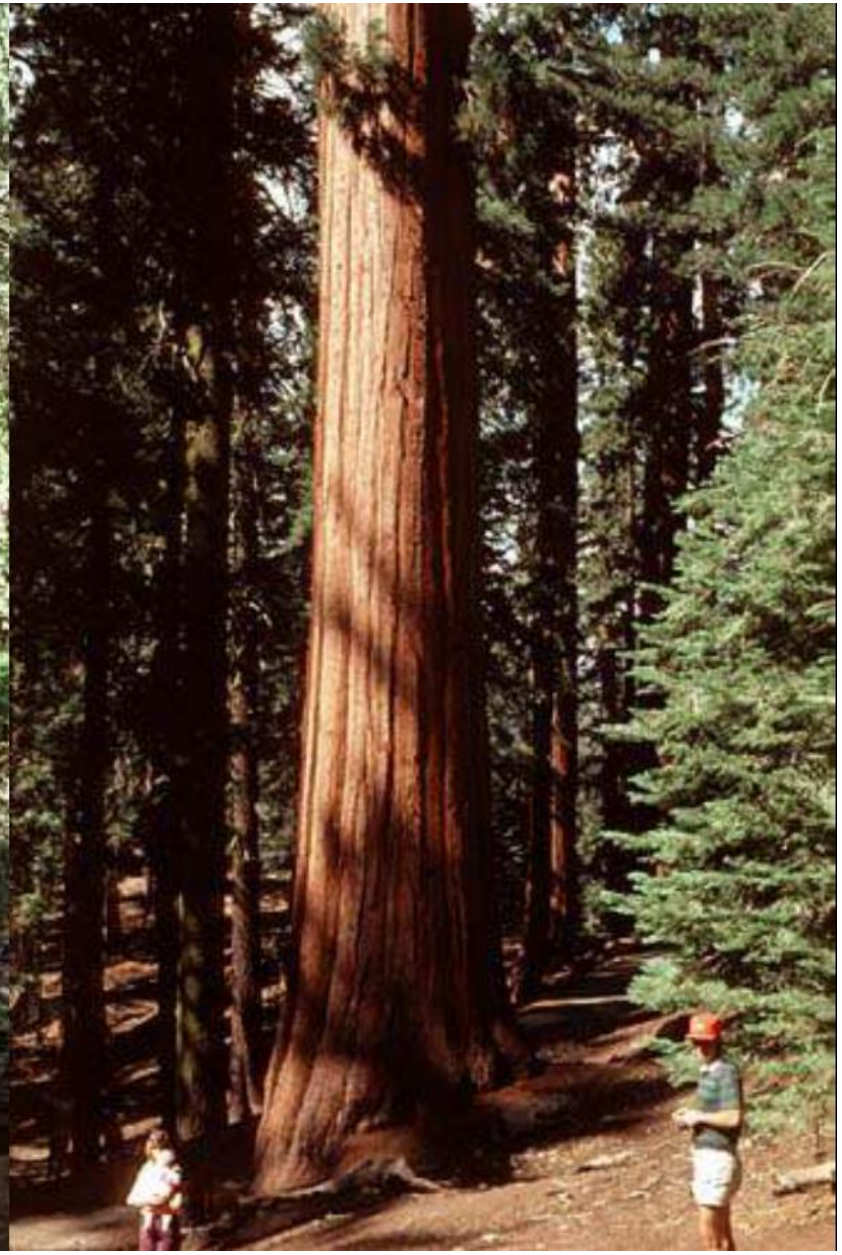
Sequoia sempervirens: as mais altas!

Aparecem na costa litorânea da Califórnia

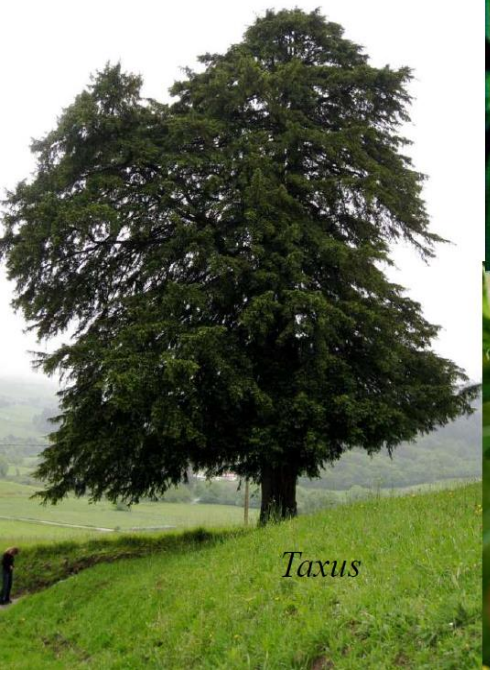
Cupressaceae



Sequoiadendron: maior volume

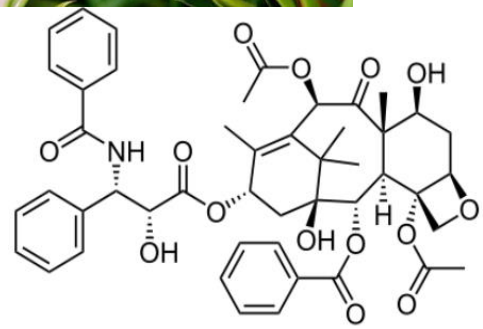


Taxaceae (exótica)









Fórmula do quimioterápico Paclitaxel (taxol), originalmente extraído da casca de *Taxus baccata*



Retirada da casca de *Taxus*. Fonte: http://en.wikipedia.org/wiki/Paclitaxel#/media/

Podocarpaceae

- Cerca de 10 espécies nativas do Brasil (mais comum *Podocarpus sellowii*).
- Microsporófilo com 2 microsporângios.
- Escamas ovulíferas com 1 óvulo.
- Semente semelhante a uma drupa



Podocarpaceae





- Semente

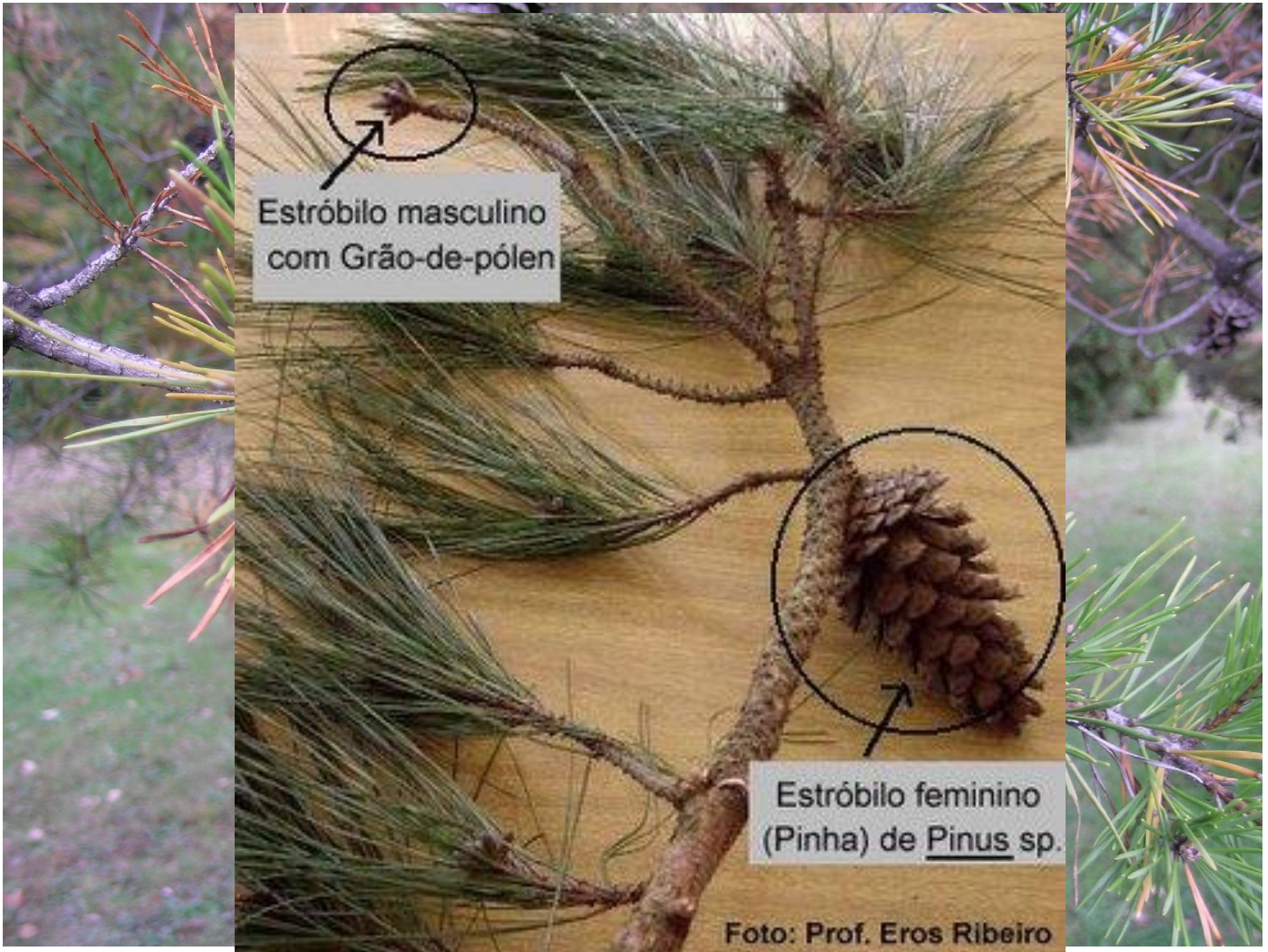
Pinaceae (maior família)

- Folhas aciculares alternas ou dispostas em feixes (**braquiblastos**)
- Estróbilo masculino alongado e pequeno e estróbilo feminino Lenhoso (Pinha) na mesma planta (**Plantas Monóicas**).
- **Microsporófilos** com **dois microsporângios** (micrósporos com 2 bolsa de ar)
- **Megasporófilo** com **2 óvulos** (protegidos na fase inicial por escama de cobertura)
- **Sementes aladas** (tegumento do megasporófilo), embrião com muitos cotilédones



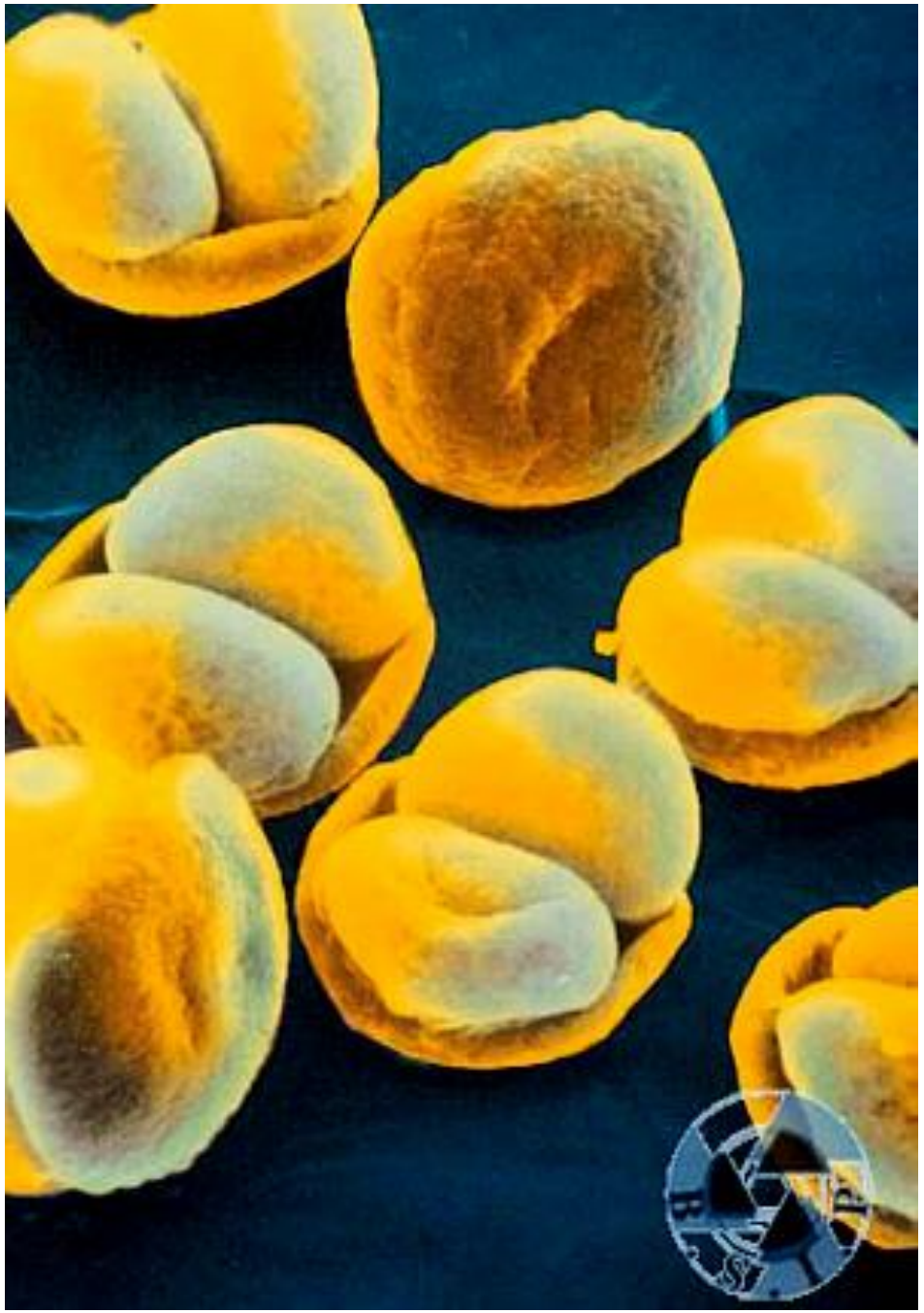


Pinus silvestris L.


Estróbilo masculino
com Grão-de-pólen
Estróbilo feminino
(Pinha) de Pinus sp.
Foto: Prof. Eros Ribeiro

- Grãos de pólen

(com sacos de ar).



Pinaceae





Pinus e Cedrus: folhas em feixes

3 gêneros:
Pinus*: Pinus Elliotti, P taeda, P patula* etc
Cedrus*: Cedrus libani* (Cedro do Líbano)
Abies*: Abies balsamea* (Balsamo do Canadá)*, A. alba* etc



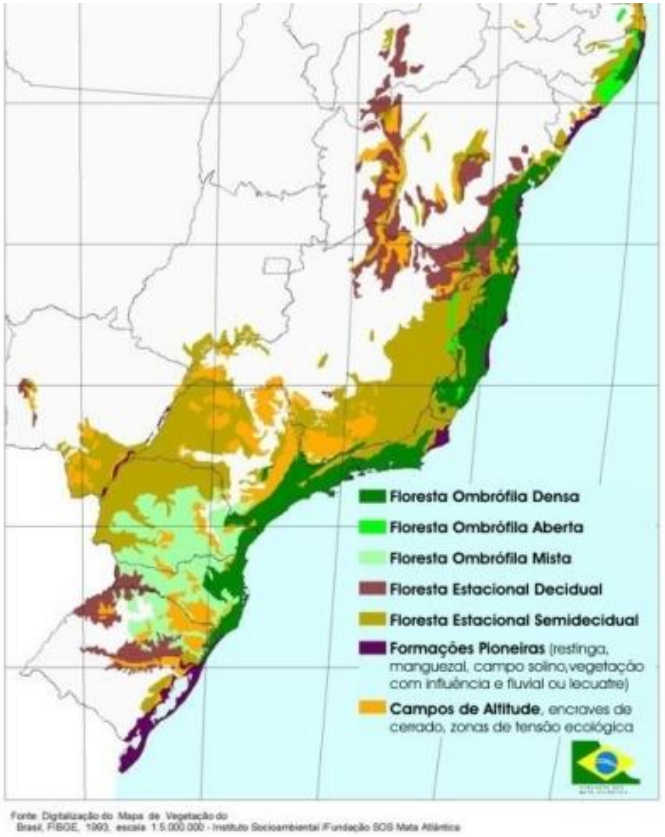
Espécie mais velha vivente está em *White Mountains of California*, com 5.060 anos



Cedrus libani

Araucariaceae





Fonte: Digitalização do Mapa de Vegetação do Brasil, FIBGE, 1993, escala 1:5.000.000 - Instituto Socioambiental /Fundação SOS Mata Atlântica

Araucaria angustifolia (Pinheiro do Paraná), que caracteriza a Floresta Ombrófila Mista ou Floresta de Araucária, típica de regiões frias do sul e sudeste brasileiro

Araucariaceae

- **1 espécie nativa do Brasil**: *Araucaria angustifolia* (Pinheiro do Paraná)
- Folhas escamiformes ou ovais, **alternas** (**sem braquiblastos**)
- Estróbilo masculino alongado e pequeno e estróbilo feminino Lenhoso, em plantas distintas (**Plantas Dióicas**).
- **Microsporófilos** com **6-8 microsporângios** (sem bolsa de ar)
- **Megasporófilo** com **1 óvulo** (protegidos por escama de cobertura todo tempo)= **pinhão**
- **Sementes comestíveis**









