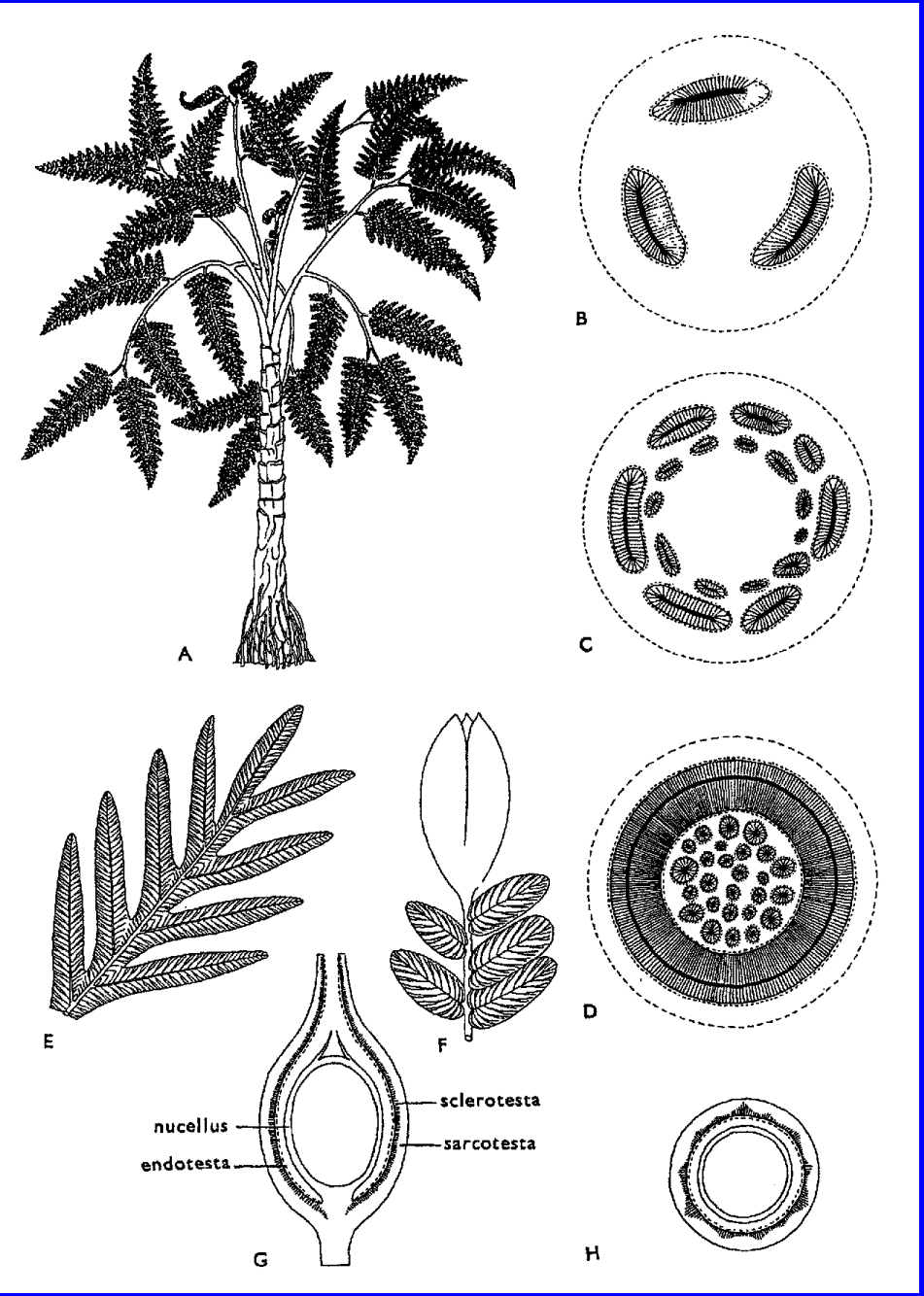
BDB 2014 Picea study day, an introduction

Paul Goetghebeur, BG Ghent University

From ferns to Gymnosperms :

from sporangia to seeds

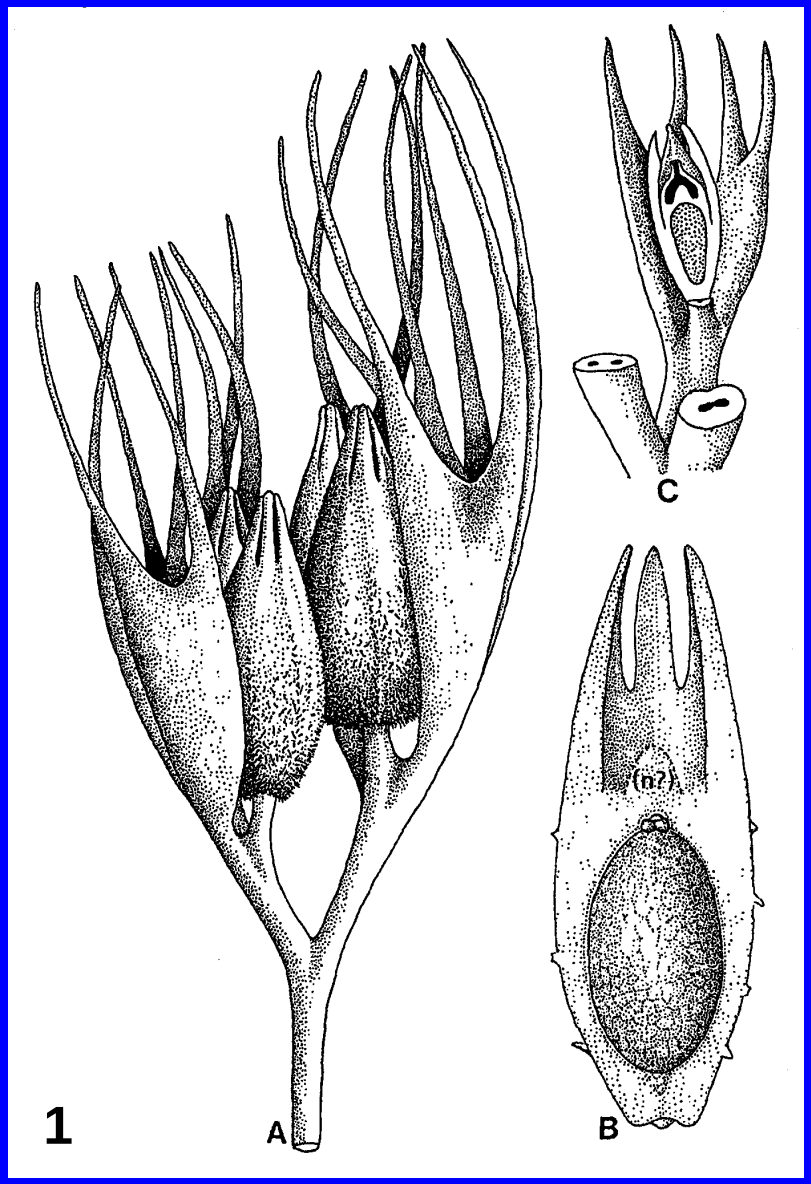
Seed ferns (fossil) : Medullosaceae

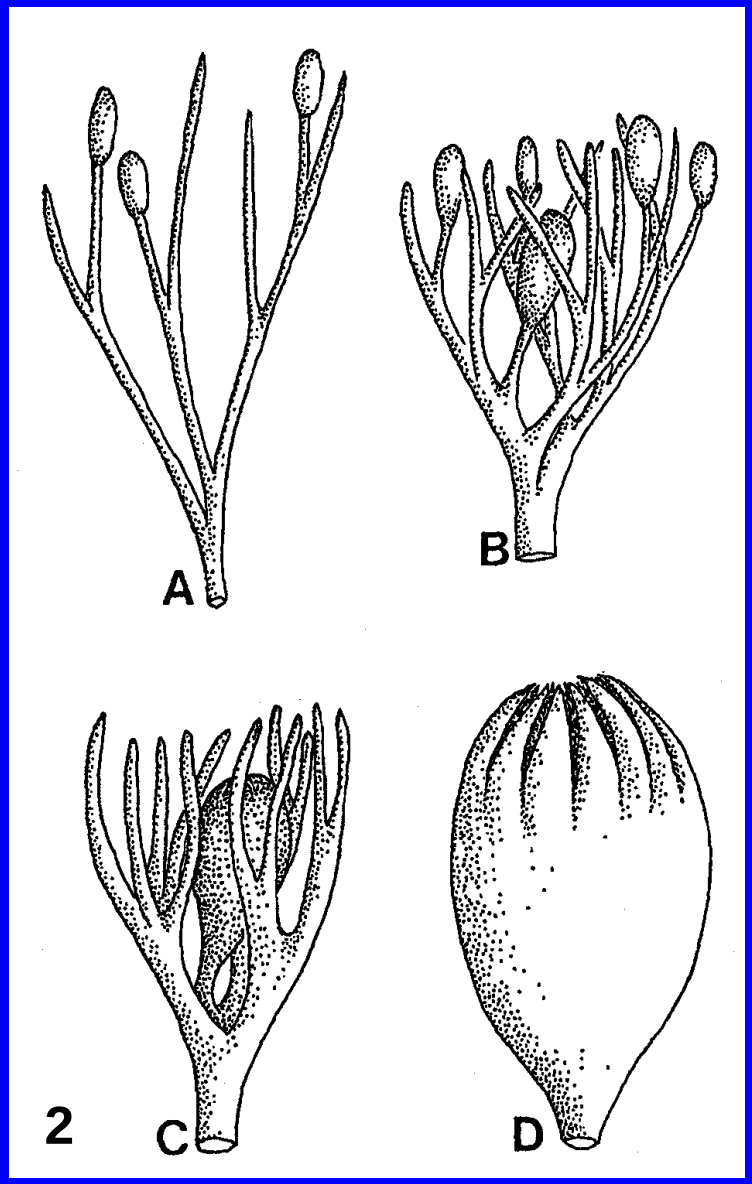


(Kalkman 1972)

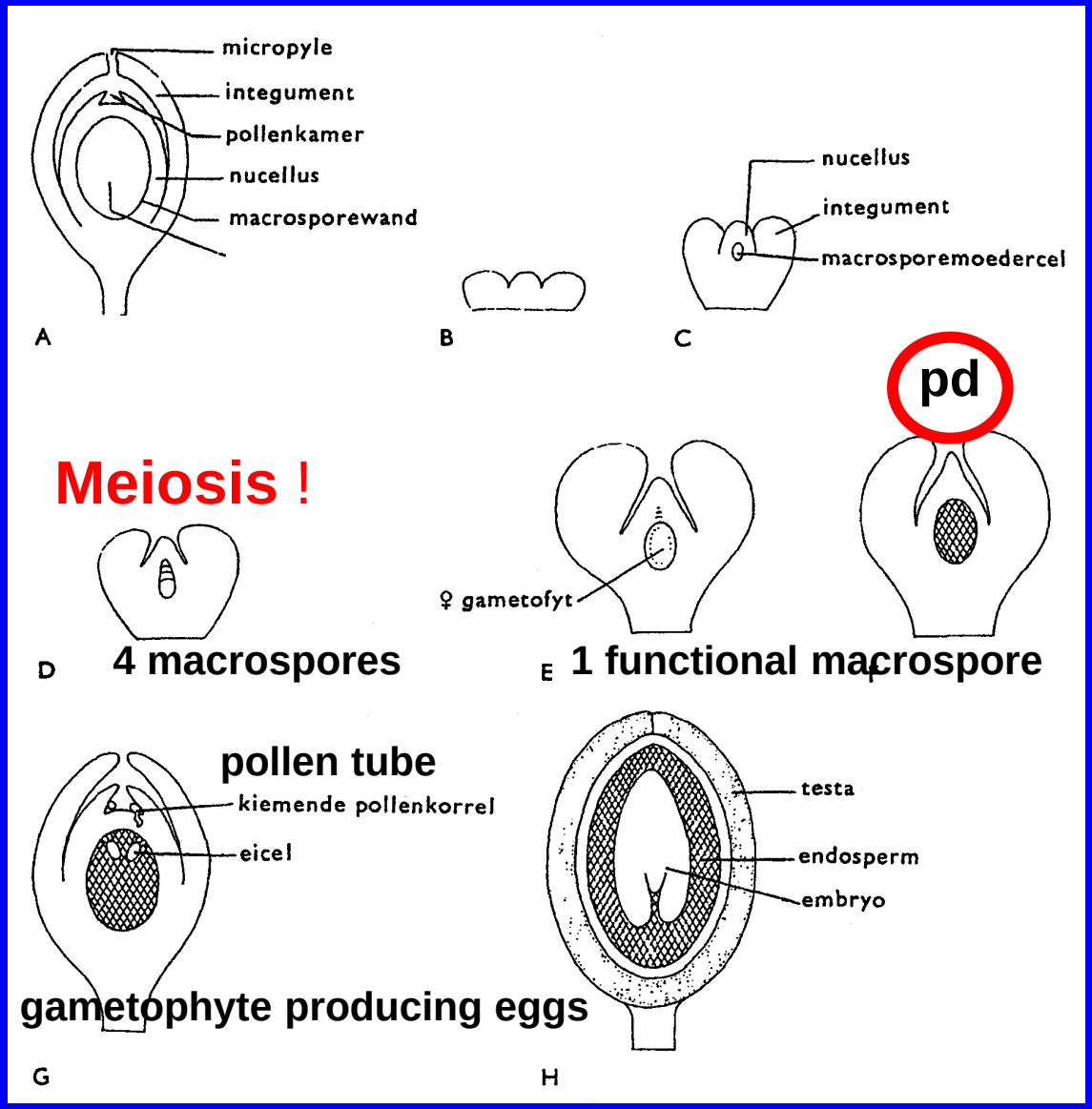
Seed ferns (fossil)

(Stewart 1983)



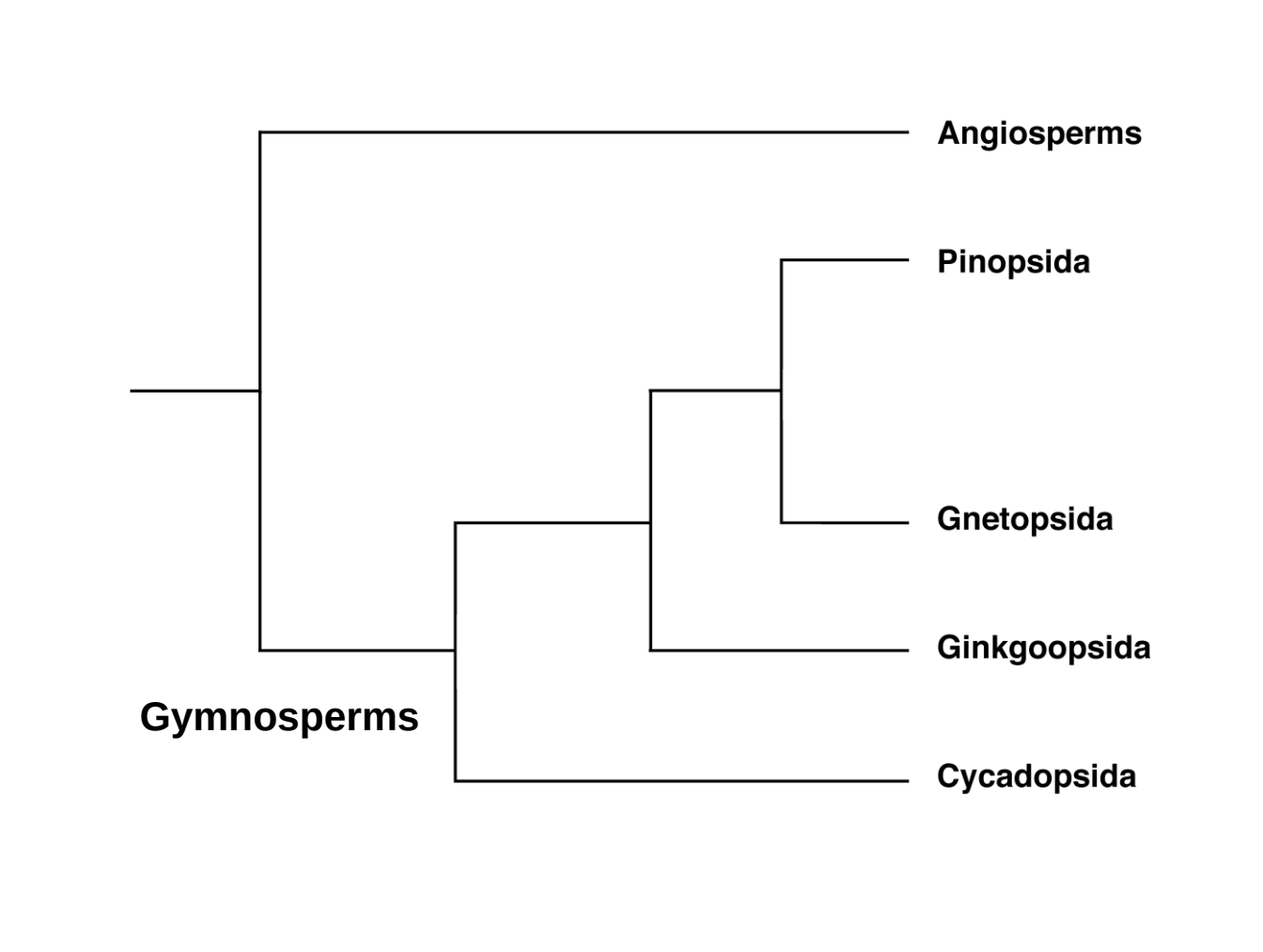


Development of the ovule in Conifers



(Kalkman 1972)

Phylogeny of the Seed Plants : 5 monophyletic groups



Cycadales :

pachycaul species with a crown of stiff leaves

Cycads *Dioon with female cone*

Cycads

Ceratozamia with female cone

Cycads

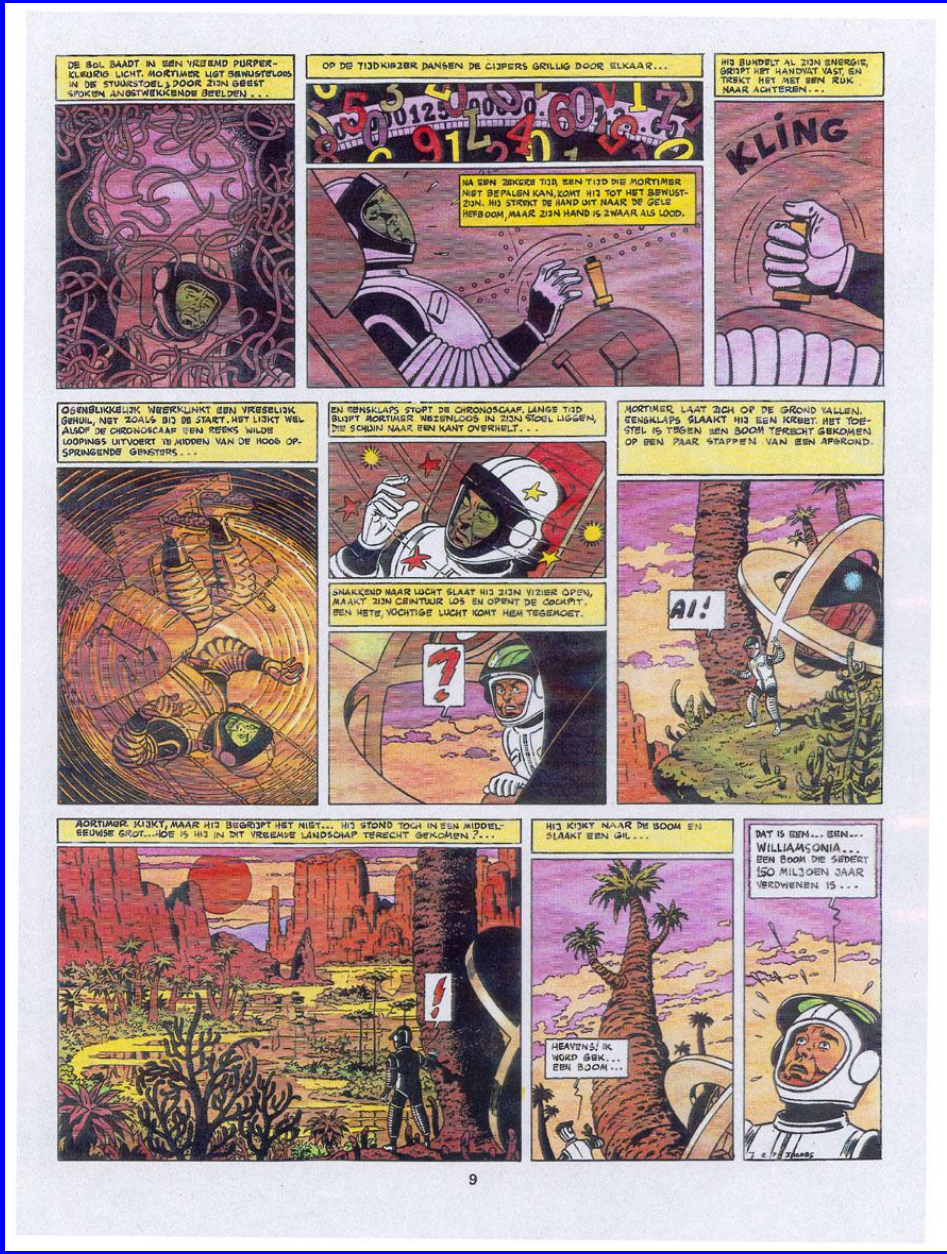
Cycas with male cone

Cycads *female Cycas with ovules*

Fossil cycads :

Williamsonia

Blake & Mortimer, by E.P.Jacobs

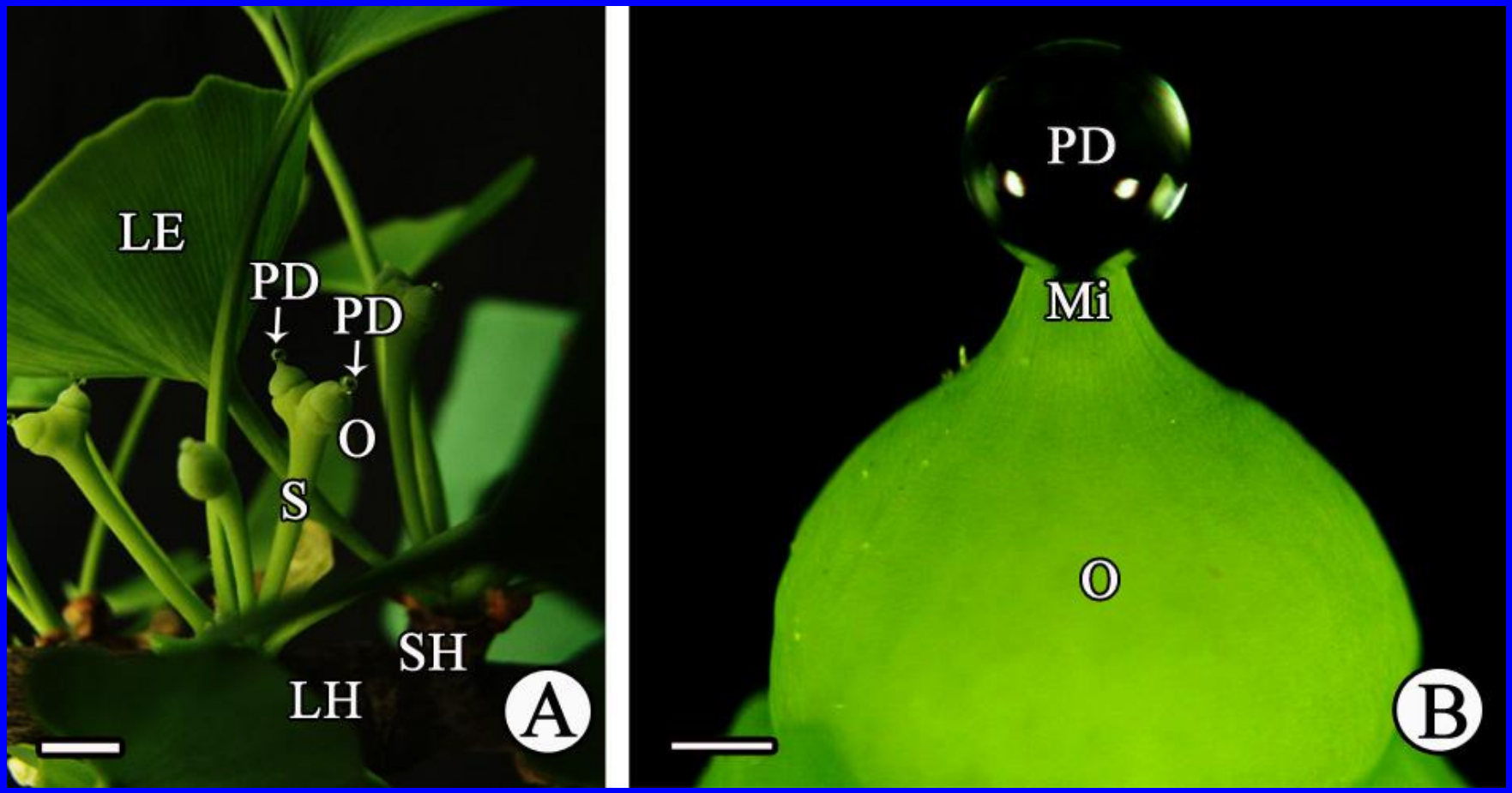


Ginkgoales :

feeling very lonely

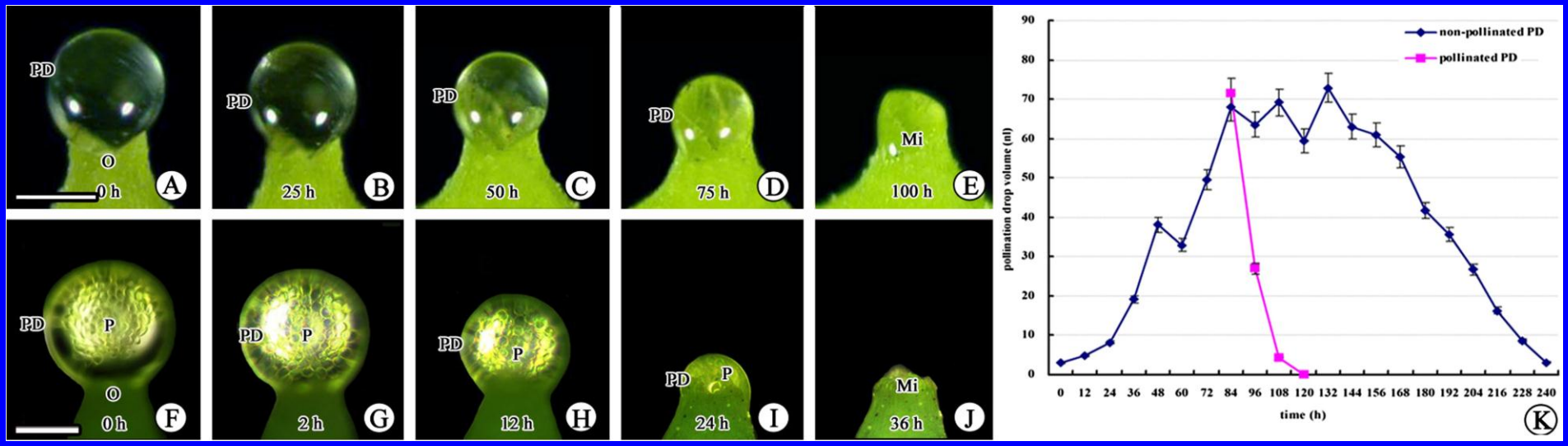
Ginkgo biloba

Ginkgo biloba *pollination drop on micropyle*



(Jin et al. 2012)

Ginkgo biloba, without and with pollen grains



(Jin et al. 2012)

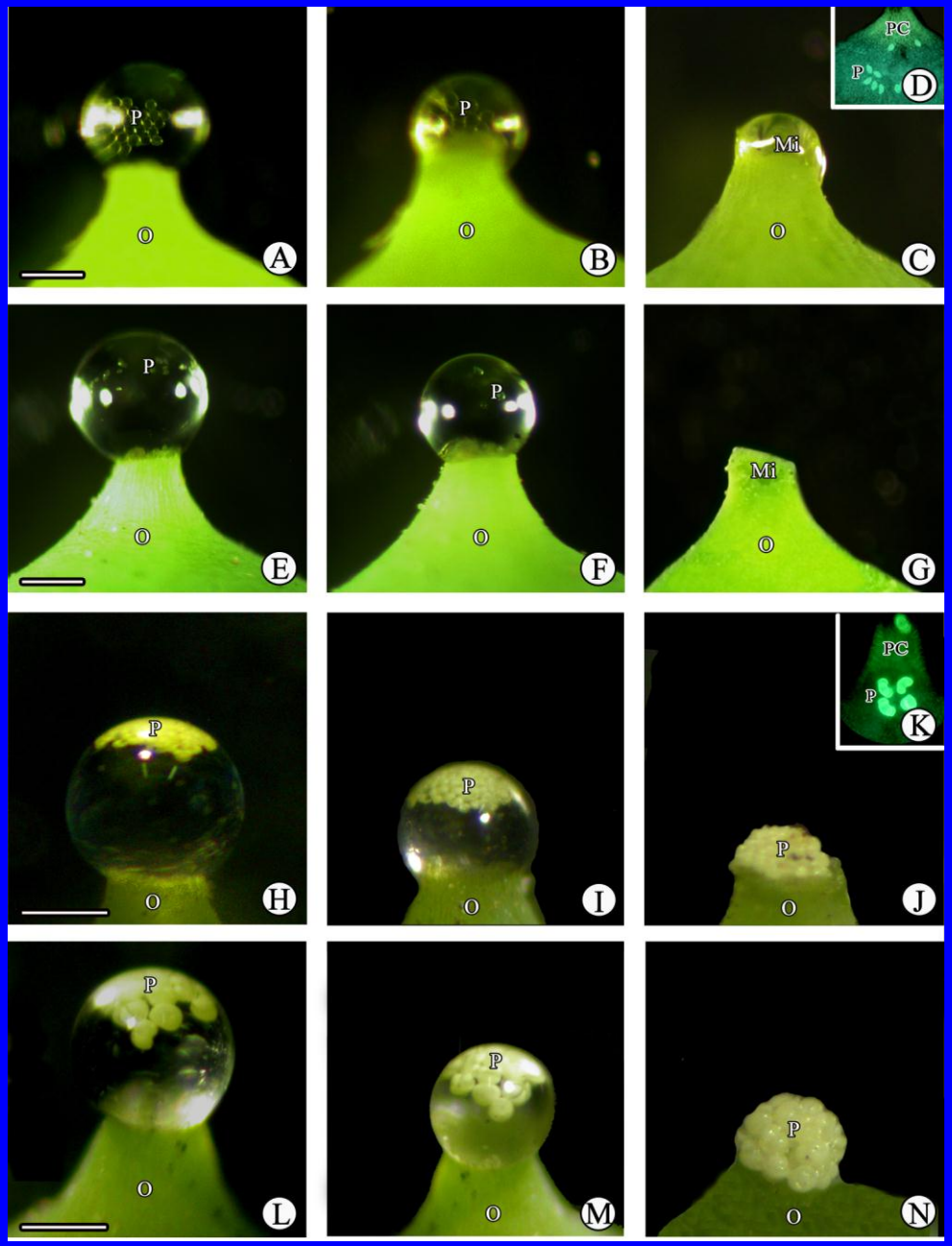
Ginkgo biloba + pollen

Ginkgo

Cycas

Pinus

Abies



Life cycle of Ginkgo biloba

Pollen tube = haustorium

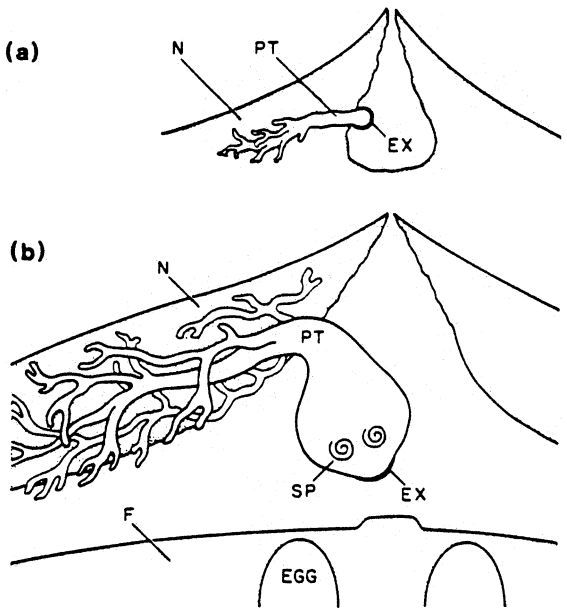
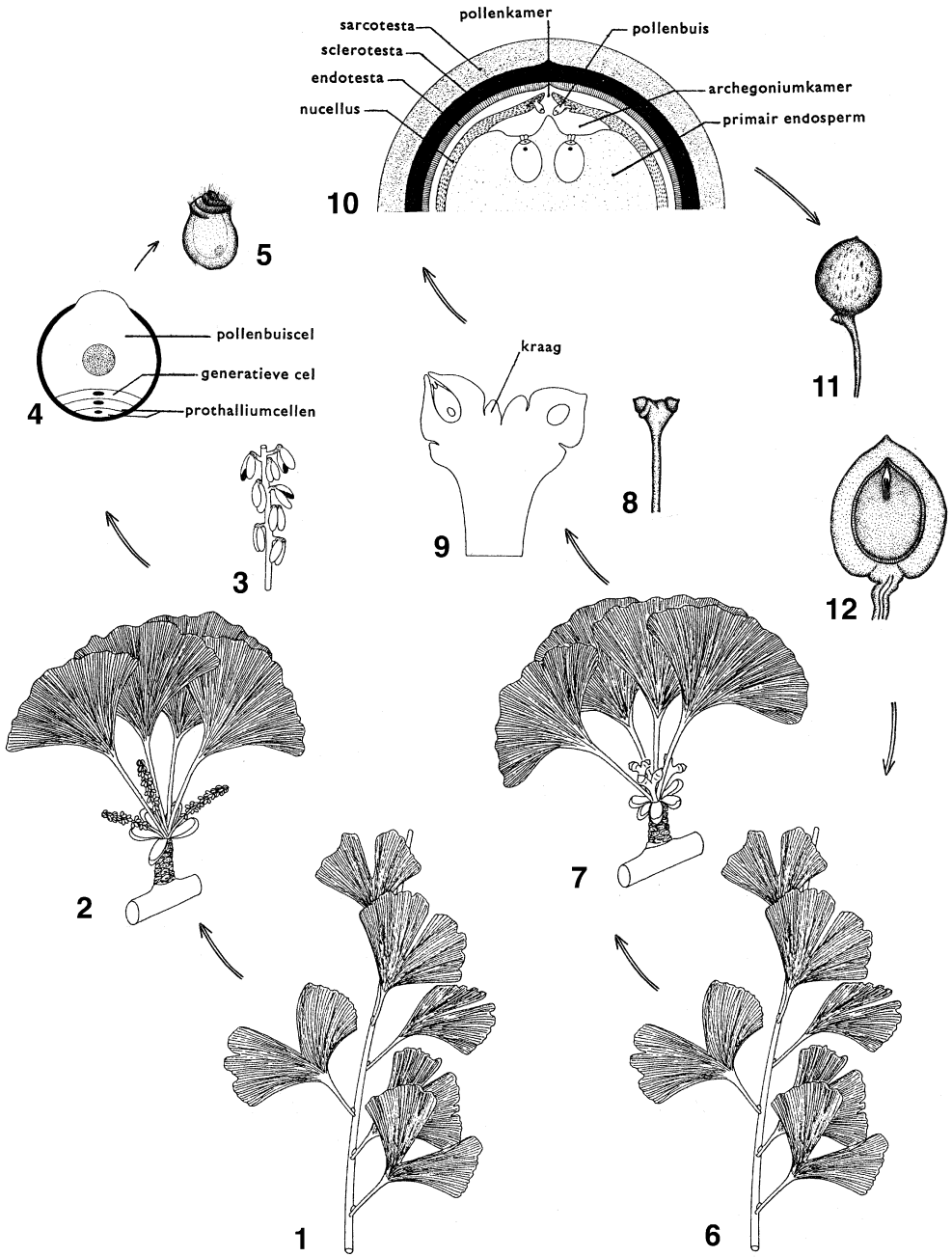


Fig. 2. Development of the male gametophyte of *Ginkgo biloba*. Early development (a) of the pollen tube involves tip growth and the formation of a branched tubular system. Late development (b) results in a metamorphosis of the basal end of the pollen tube (the end closest to the pollen grain) into a spherical structure. Multiflagellate sperm are released by the male gametophyte when the basal portion of the pollen tube ruptures. EX, pollen grain exine; F, female gametophyte; N, nucellus; PT, pollen tube; SP, sperm.



Ginkgo biloba, habit : short shoots with seeds

Gnetales :

three bizarre genera

Gnetum, “flowers” and seeds

Ephedra viridis (Mojave desert)

Ephedra distachya :

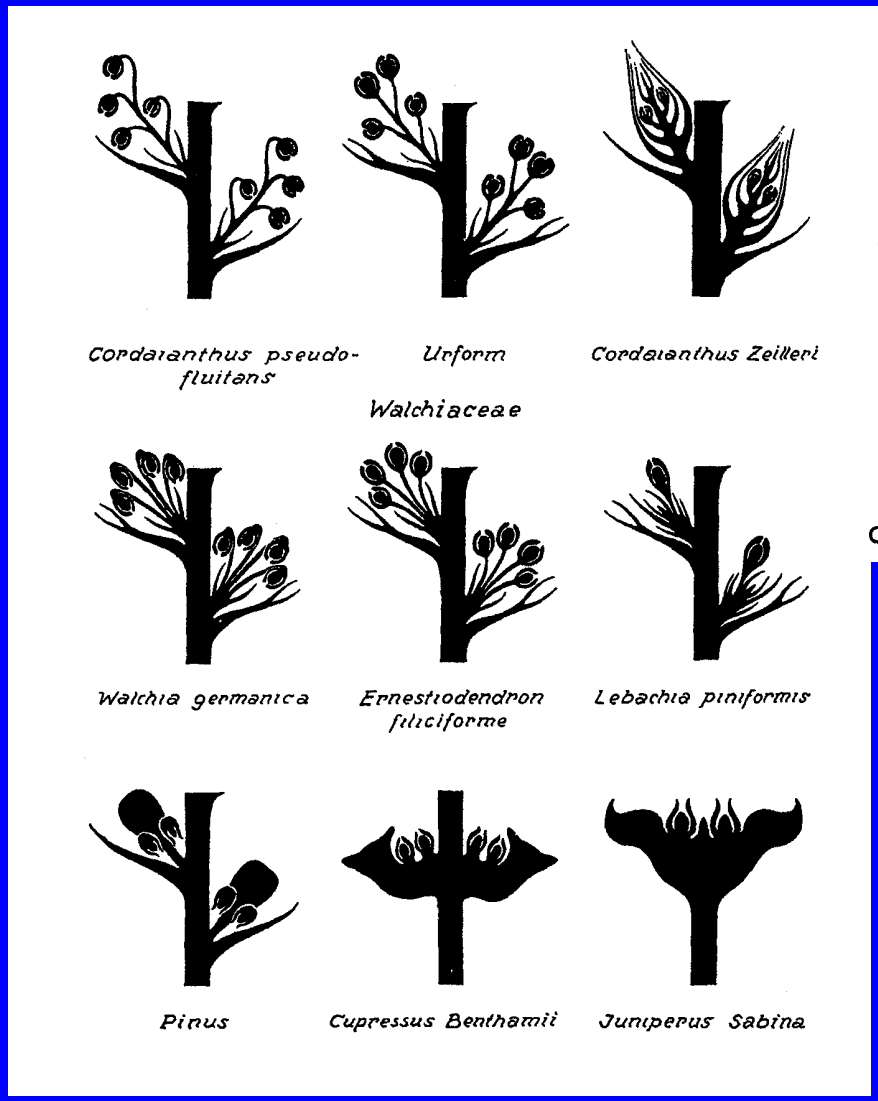
dry seeds
included by fleshy scales

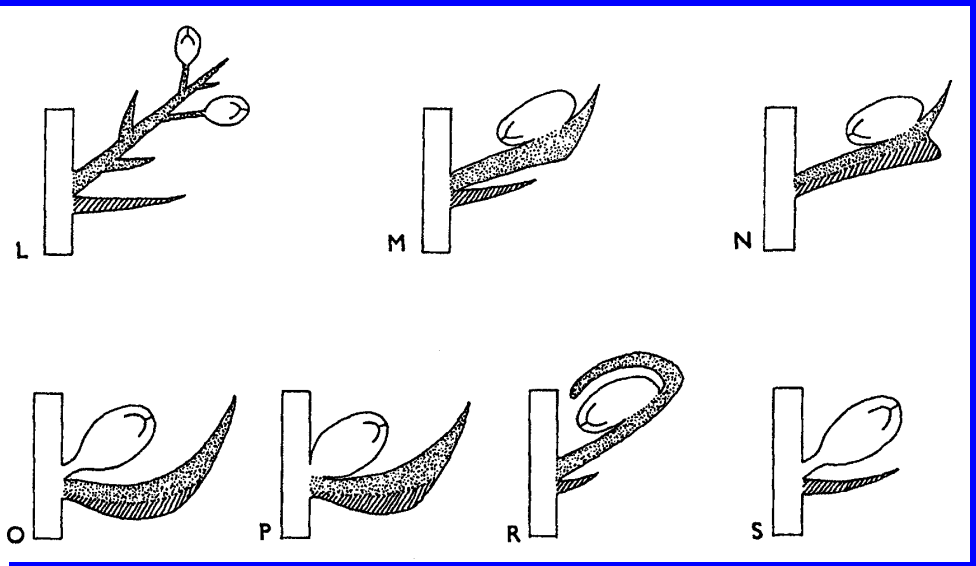
Welwitschia mirabilis in the Namib desert

Welwitschia mirabilis

Conifers : producing complex cones

Complex cones of Conifers, a survey



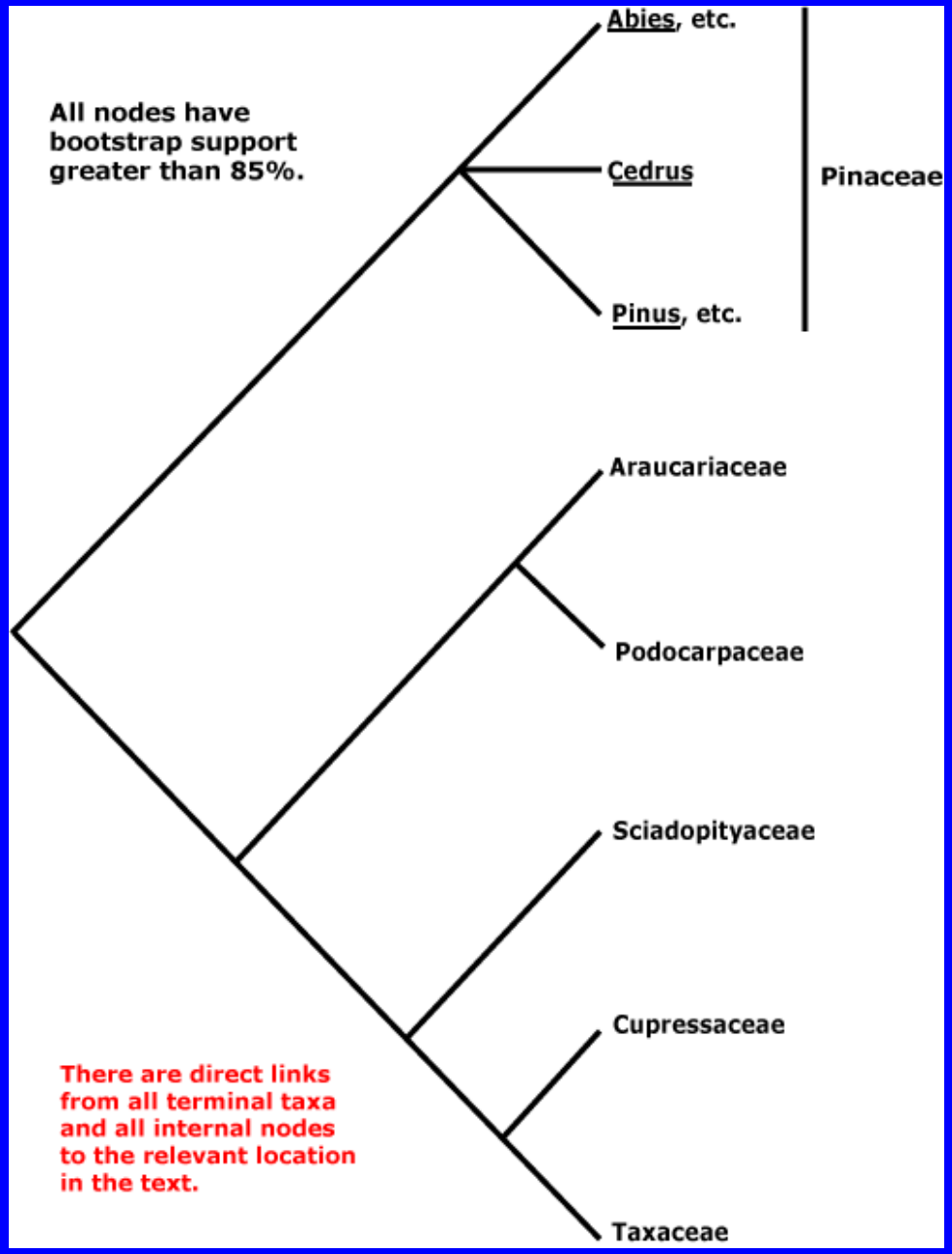


(Kalkman 1972)

(Florin 1951)

Conifers = Pinales

6 families



(AP Web 2013)

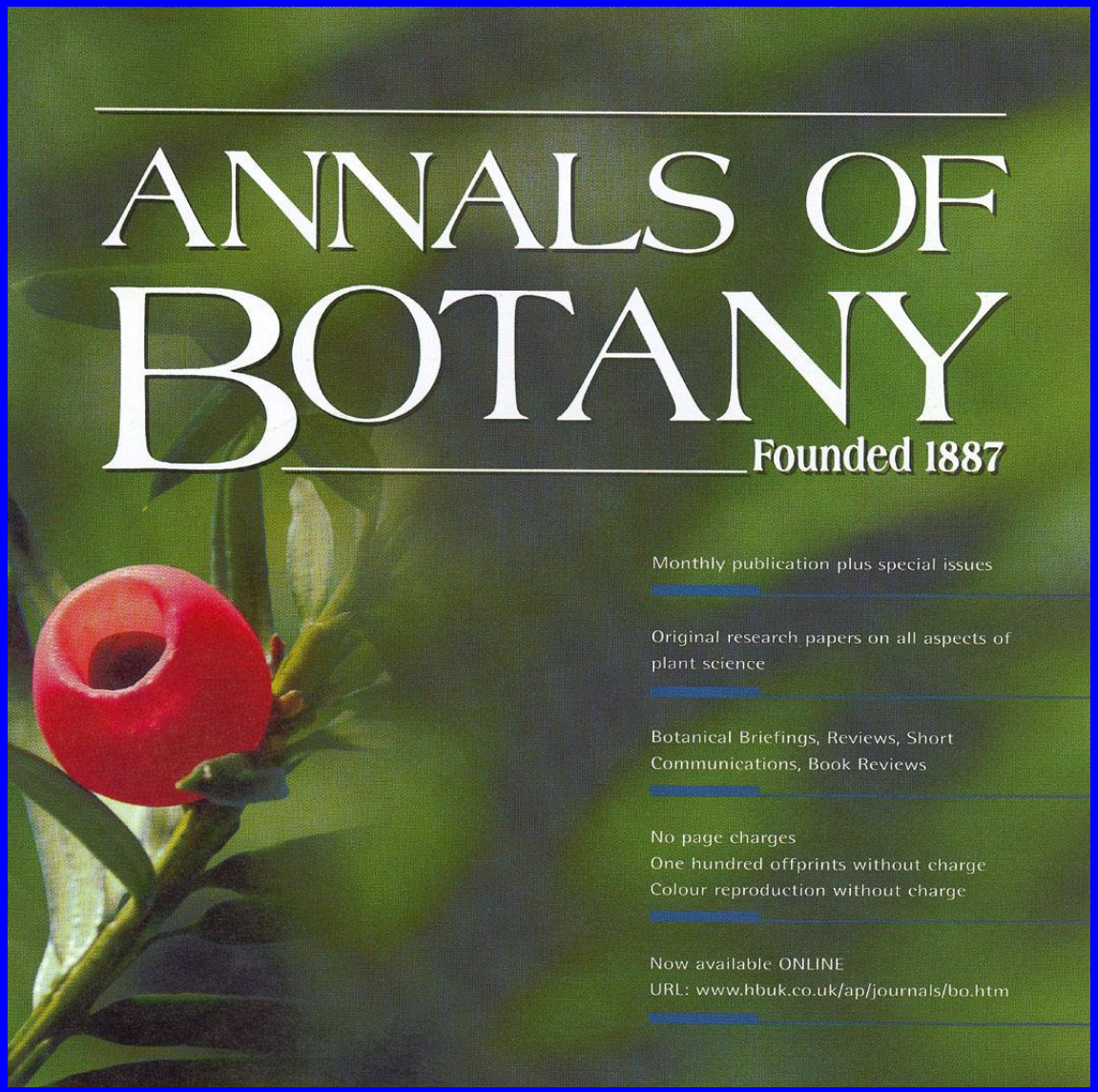
Araucariaceae (3) *Araucaria araucana*

Podocarpaceae (19) *Podocarpus elatus*

Sciadopityaceae (1) *Sciadopitys verticillata*

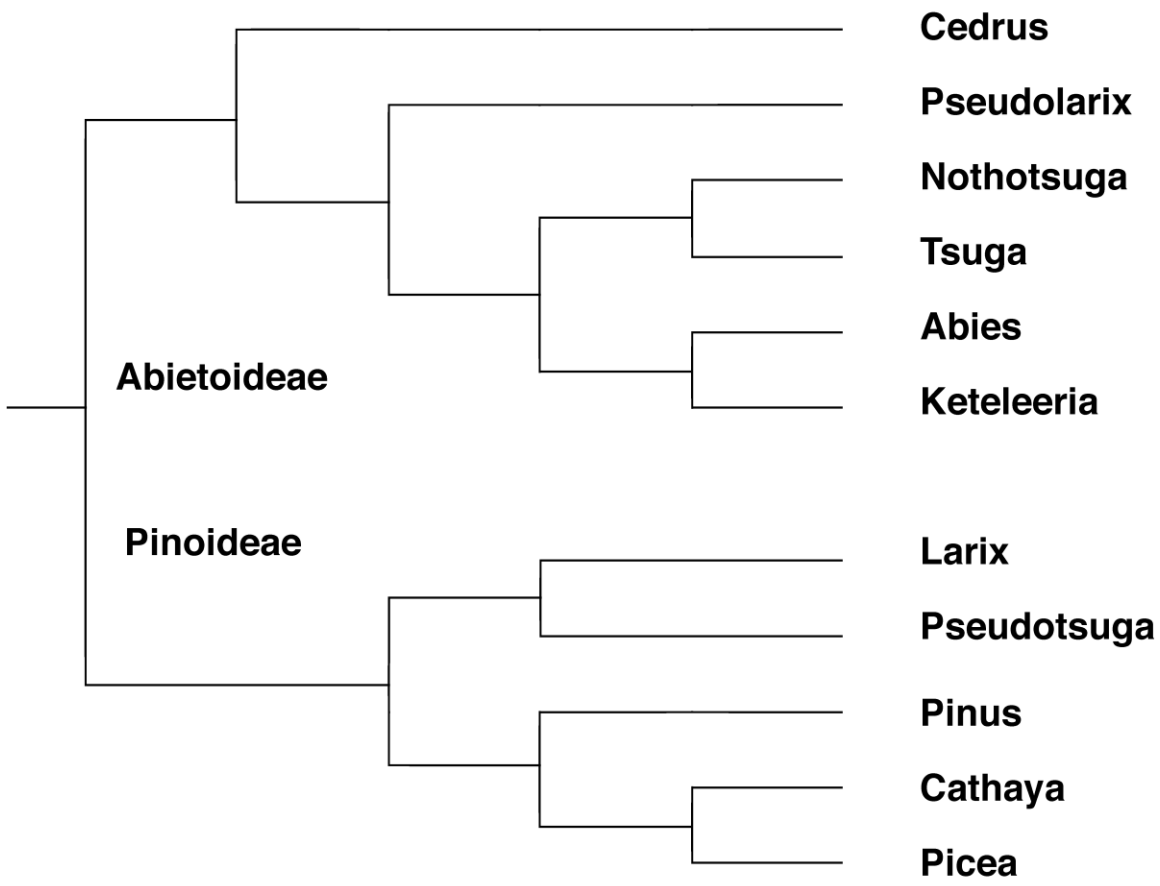
Cupressaceae (29) *Chamaecyparis obtusa*

Taxaceae (6) *Taxus baccata*



Pinaceae :
new branches becoming woody in 1st year

Pinaceae : 11 genera, 232 species



Abietoideae vs Pinoideae

	Abietoideae	*Pinoideae*
Ovulate cones	*erect (exc. Tsuga)*	*hanging*
Cone scales	*narrow base*	*broad base*
	deciduous or persistent	*persistent*
Resin vesicles on seed	*present*	*absent*

Pinaceae

Abies	*50*
Cathaya	*1*
Cedrus	*4*
Keteleeria	*3*
Larix	*11*
Nothotsuga	*1*
Picea	*37*
Pinus	*111*
Pseudolarix	*1*
Pseudotsuga	*4*
Tsuga	*9*
11	*232*

Picea : leaf base very prominent & soon woody

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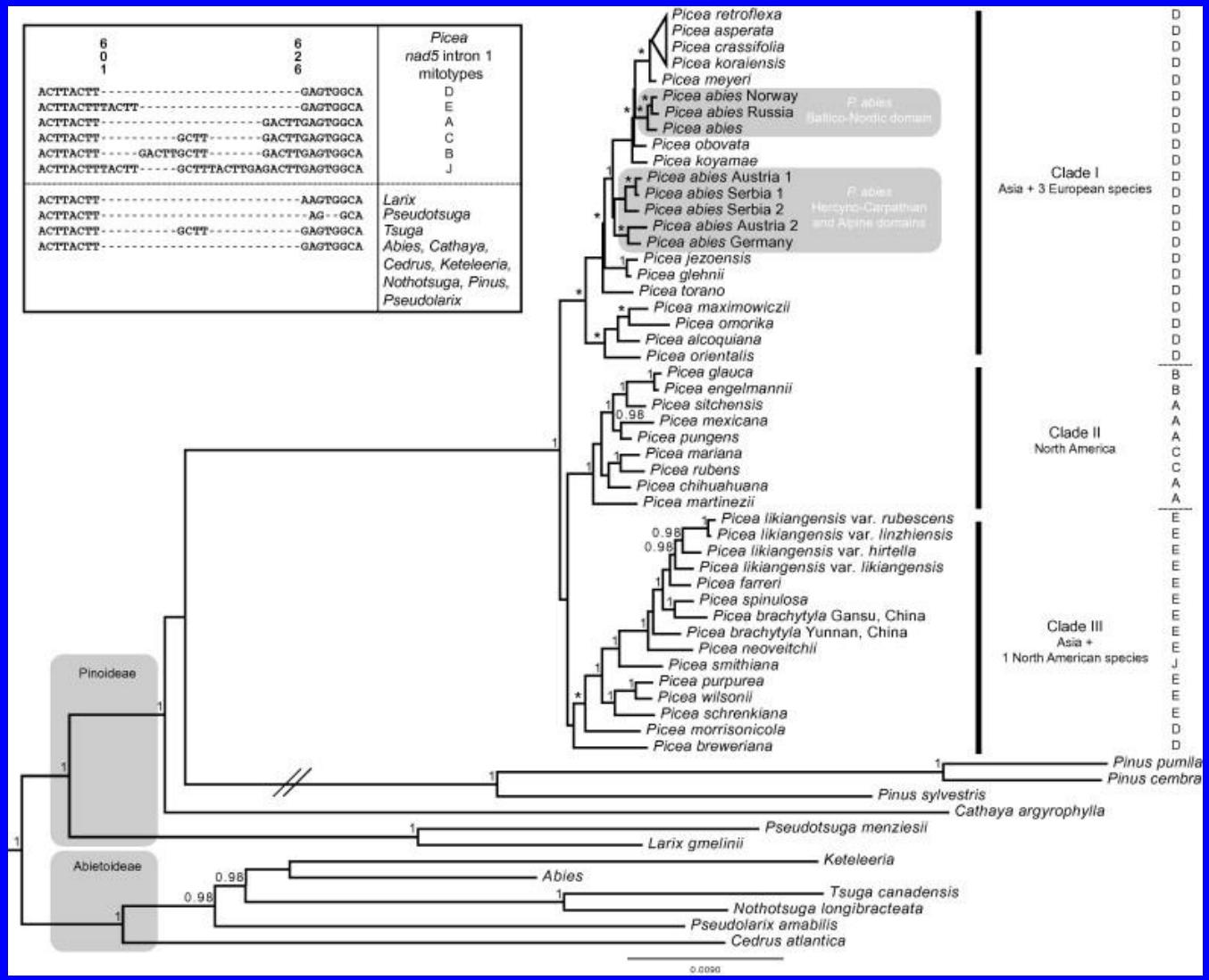
Picea phylogeny (Lockwood et al. 2013)



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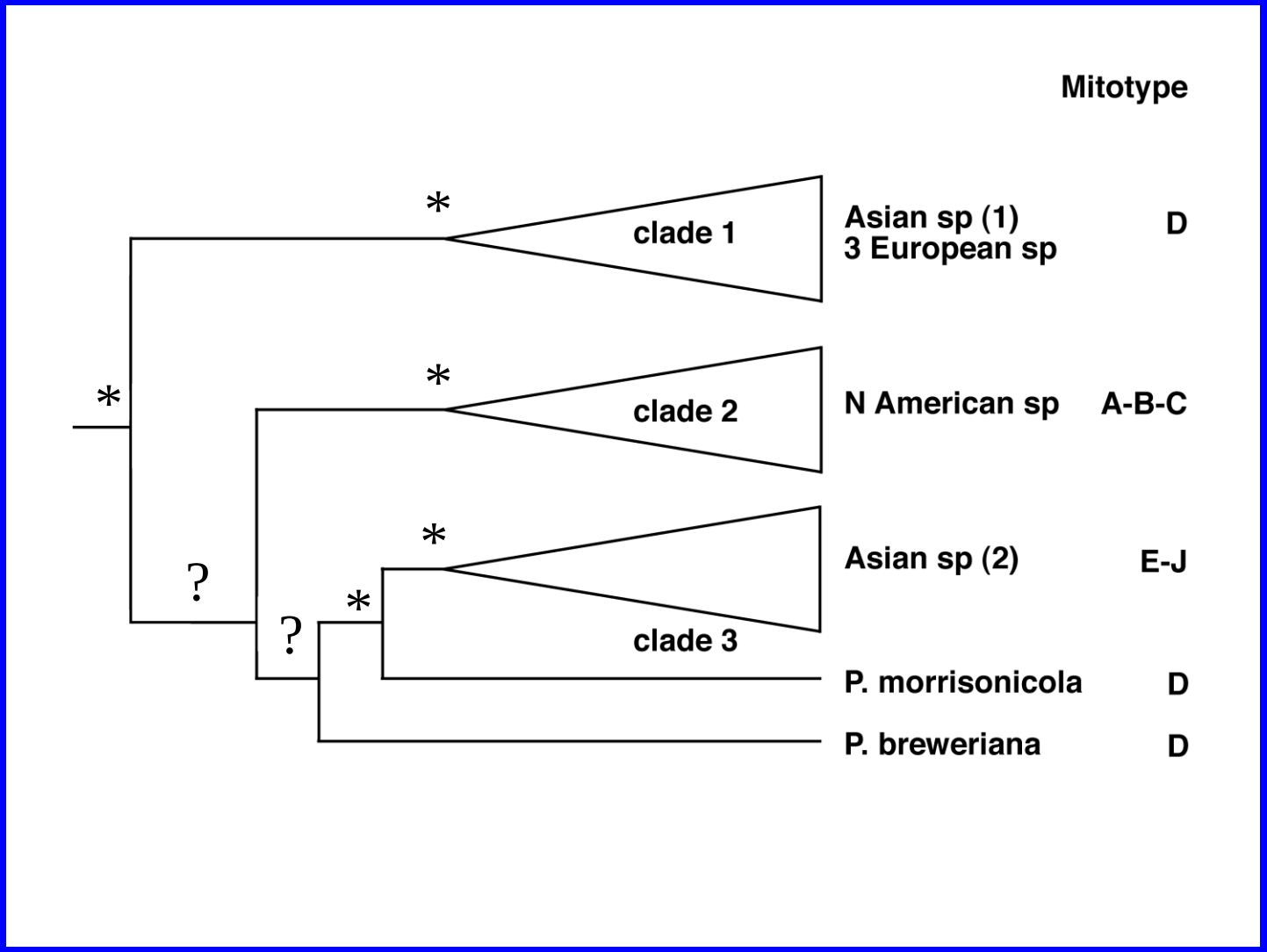
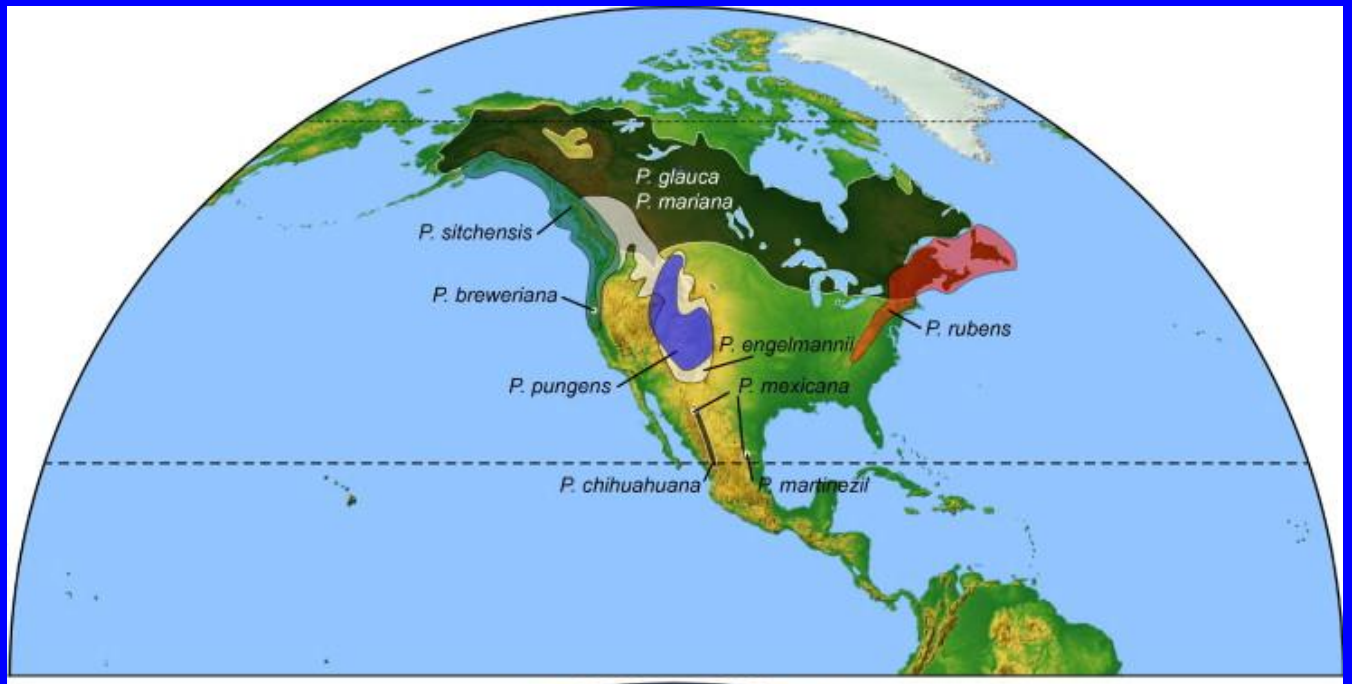
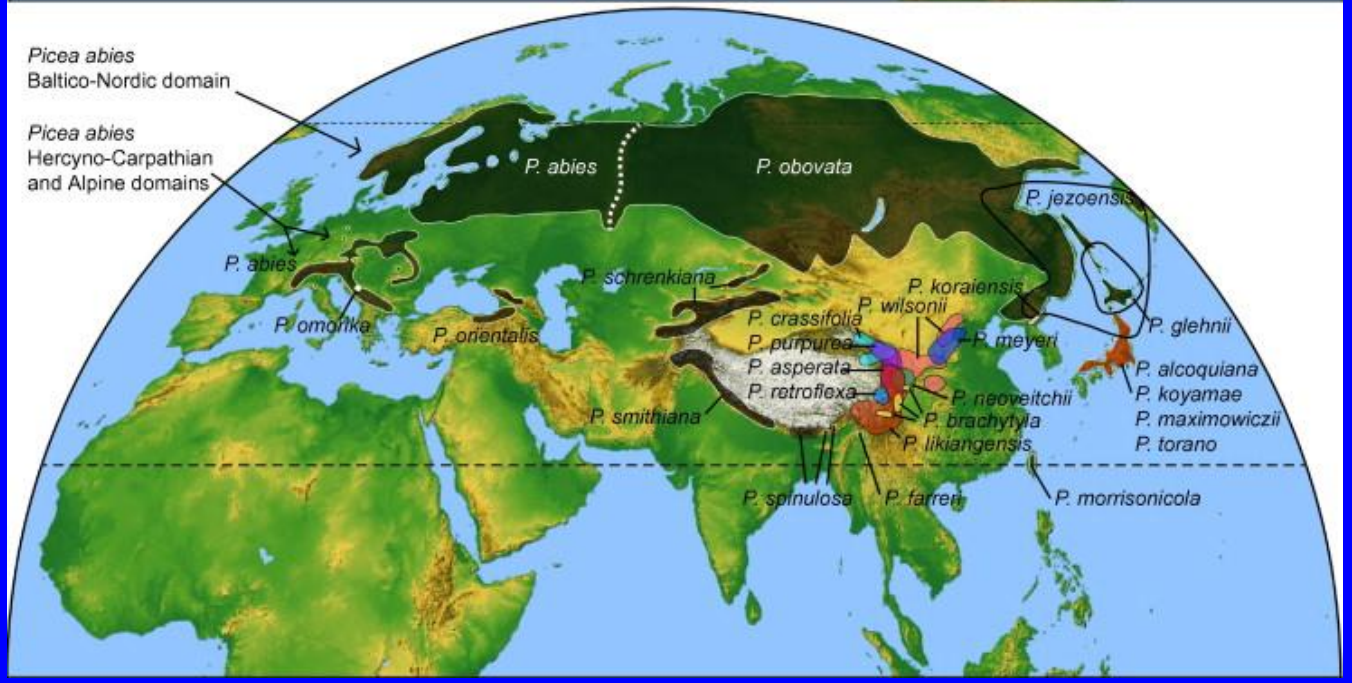


Area of all species of Picea

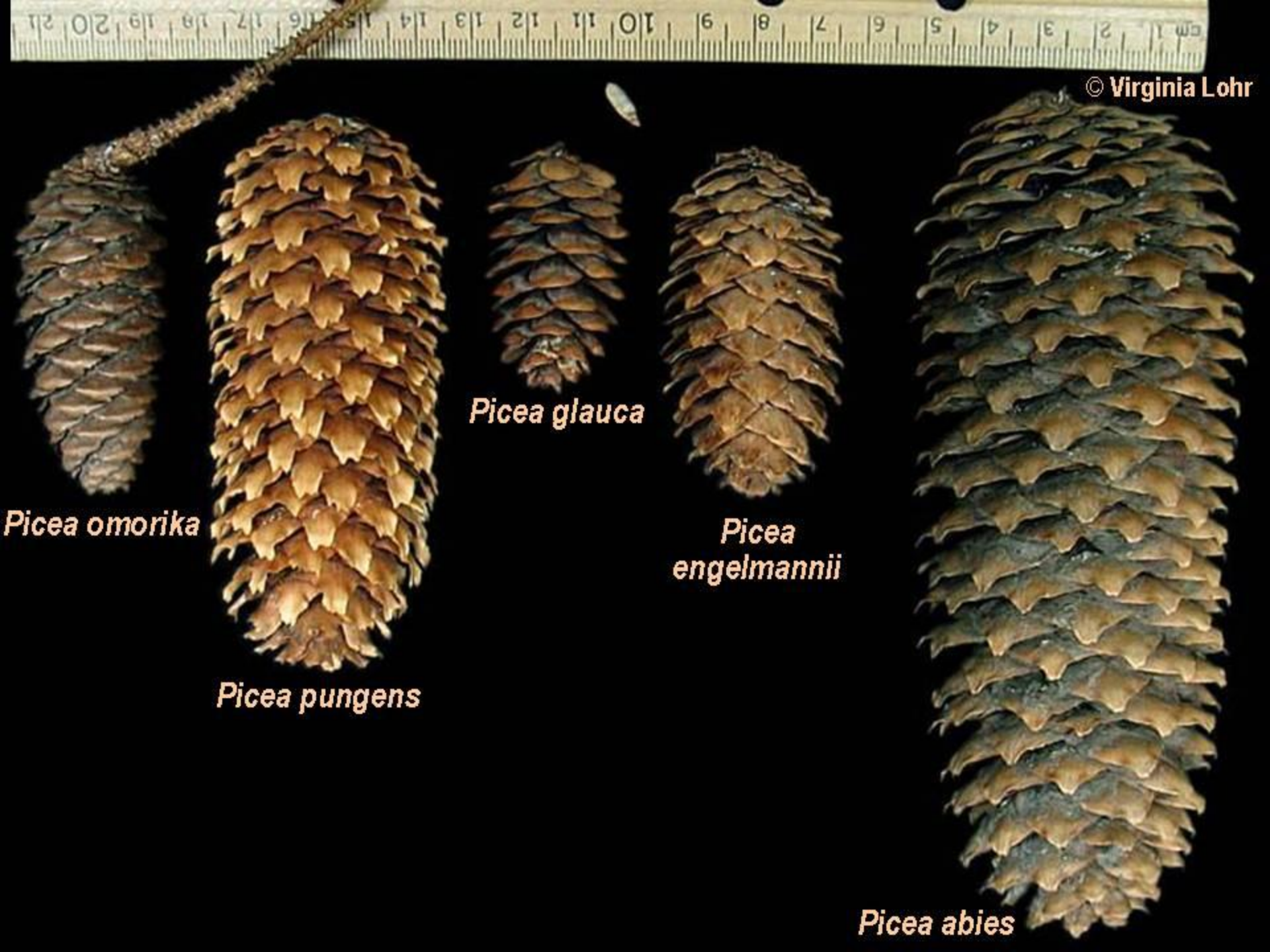




(Lockwood et al. 2013)

Picea species

P. mariana *P. glauca* *P. engelmannii* *P. sitchensis* *P. pungens* *P. abies*


© Virginia Lohr
Picea omorika
Picea pungens
Picea glauca
Picea engelmannii
Picea abies

The take home message

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Gymnosperms : 4 monophyletic groups

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Many gymnosperms are producing pollination drops

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Cycads & *Ginkgo* with haustorial pollen tube & motile spermatozoids

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Pinales and Gnetales pollen tube : transporting sperm cells to egg cell

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Picea : leaf base very prominent and soon woody

Picea : morphology rather uniform, not congruent with molecular phylogeny

A sincere « Thank you » to :

BDB

Jan De Langhe

Jean-Philippe Rameau
Anne Sofie von Otter
Cristina Branco

Matthias Goerne, listen to :
Oh du mein holder Abendstern


1 cm