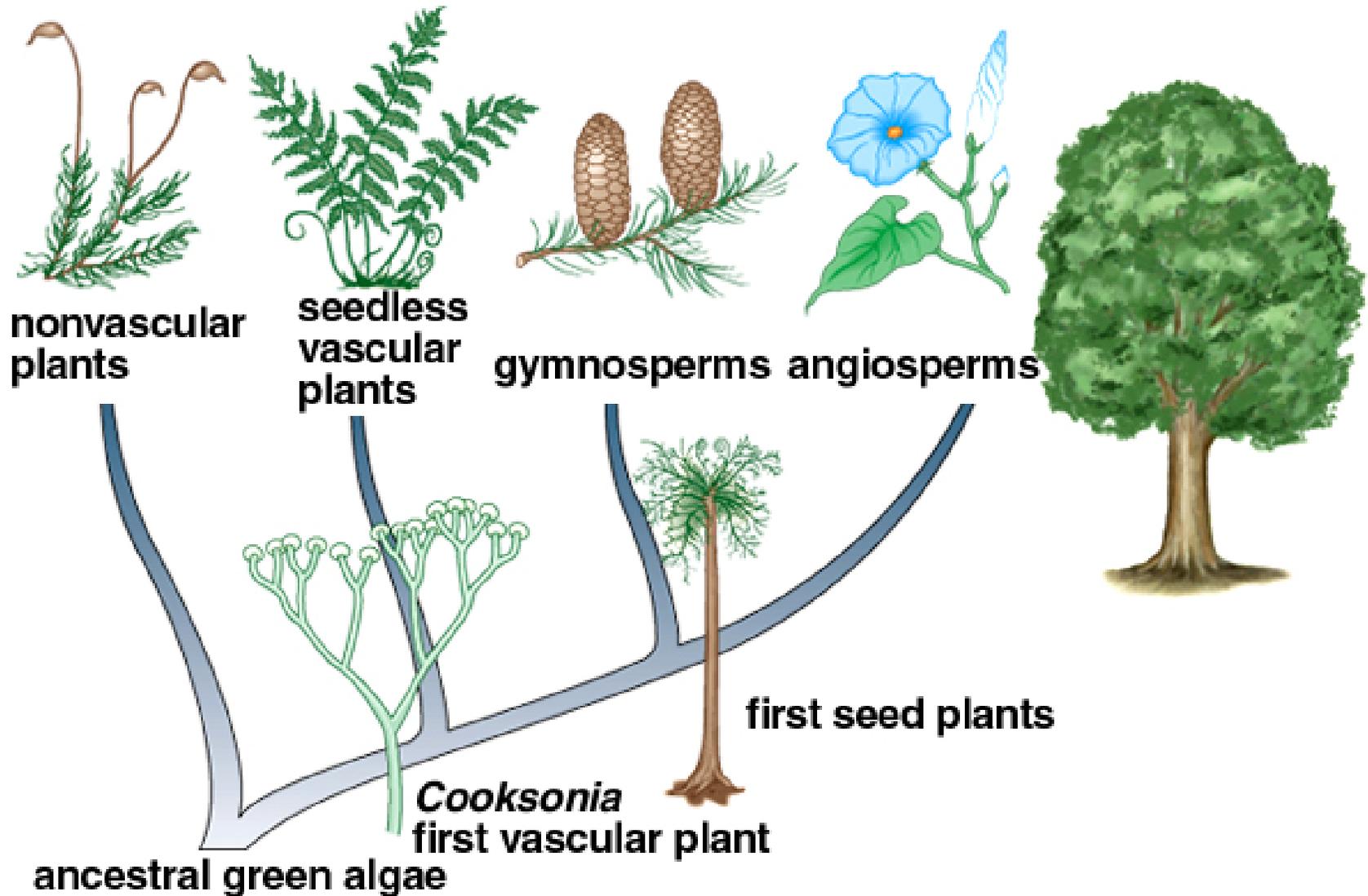
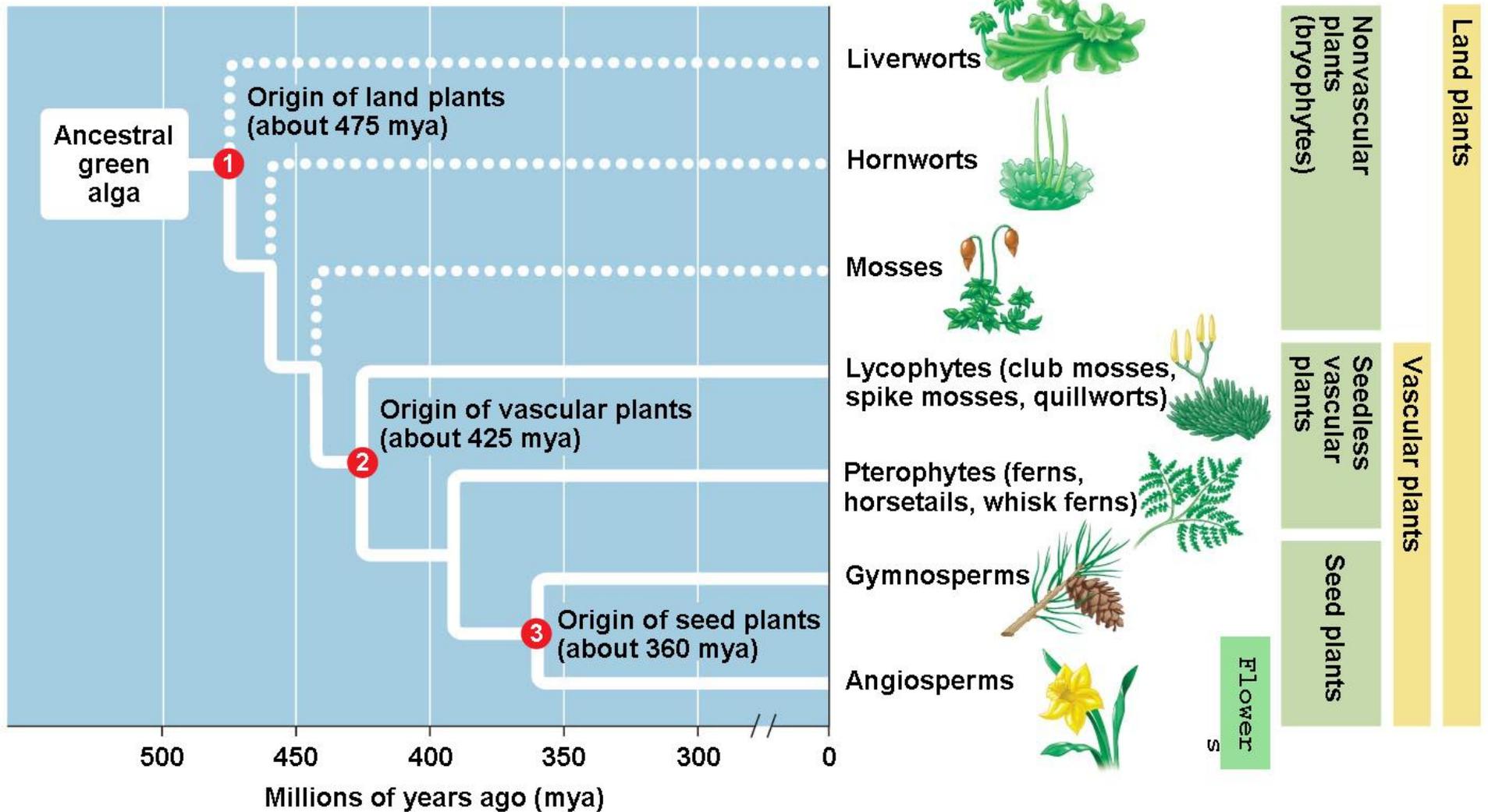


# Seed-bearing Plants

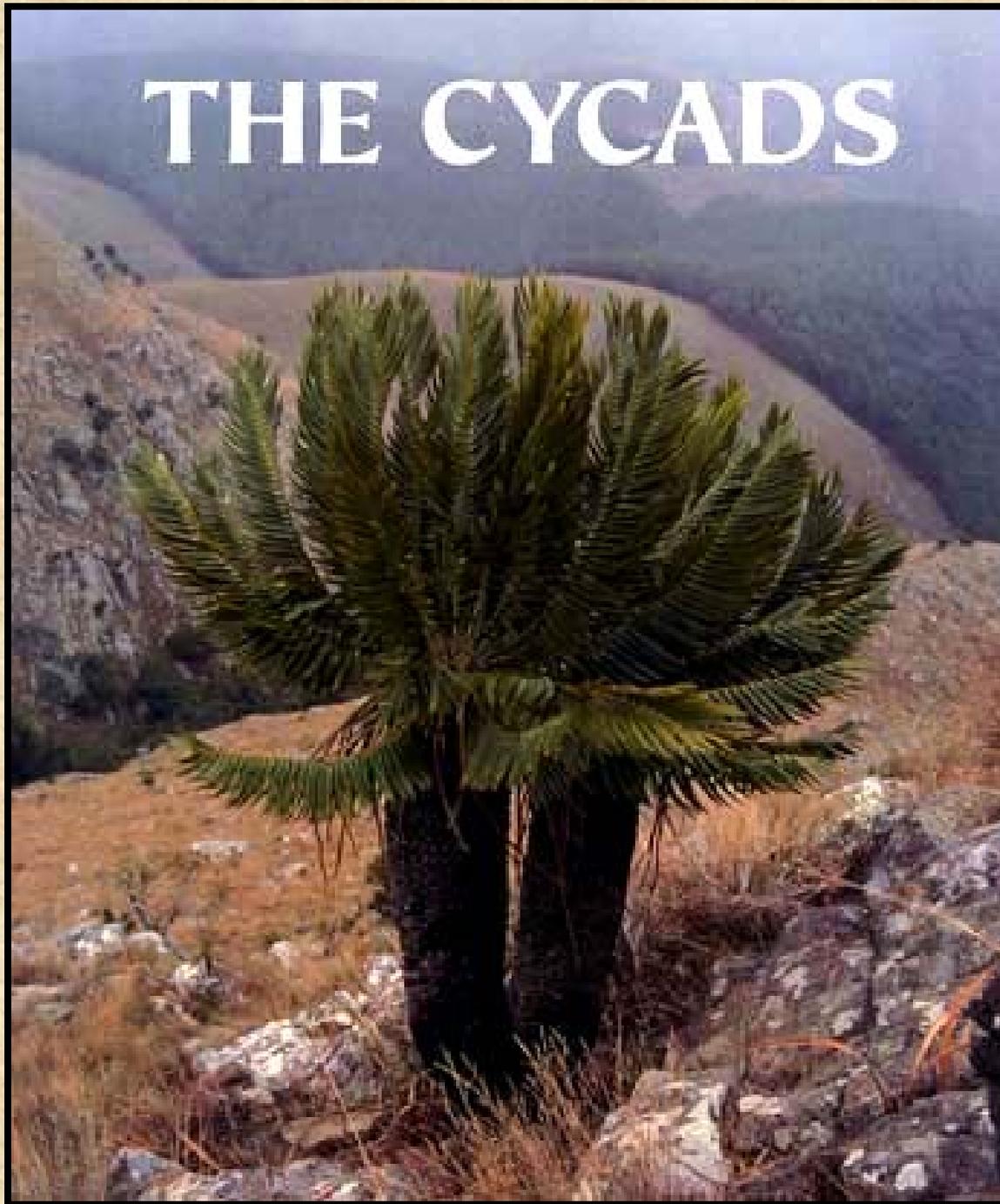


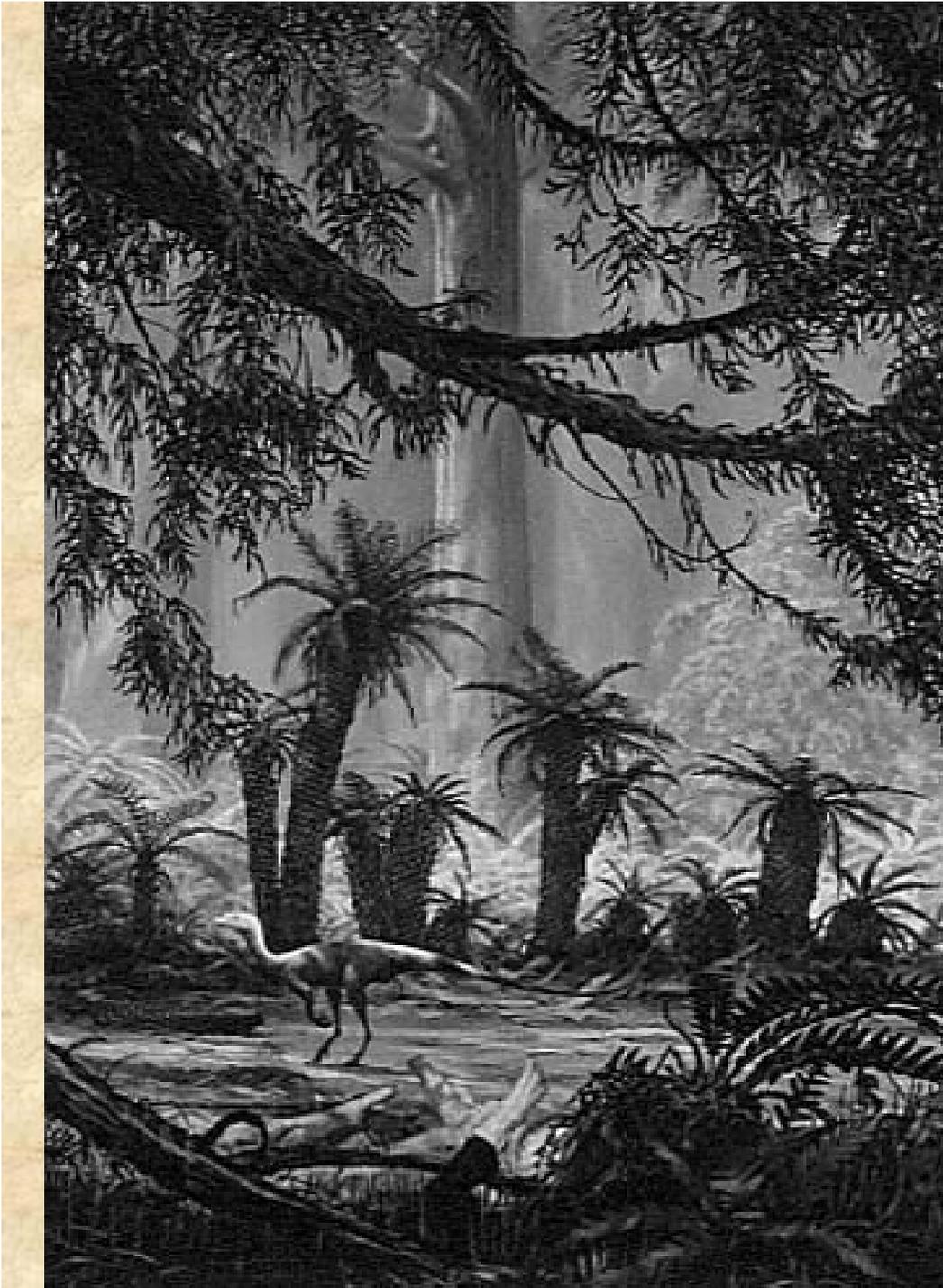
# Evolution of the major groups of plants (simplified)





# THE CYCADS

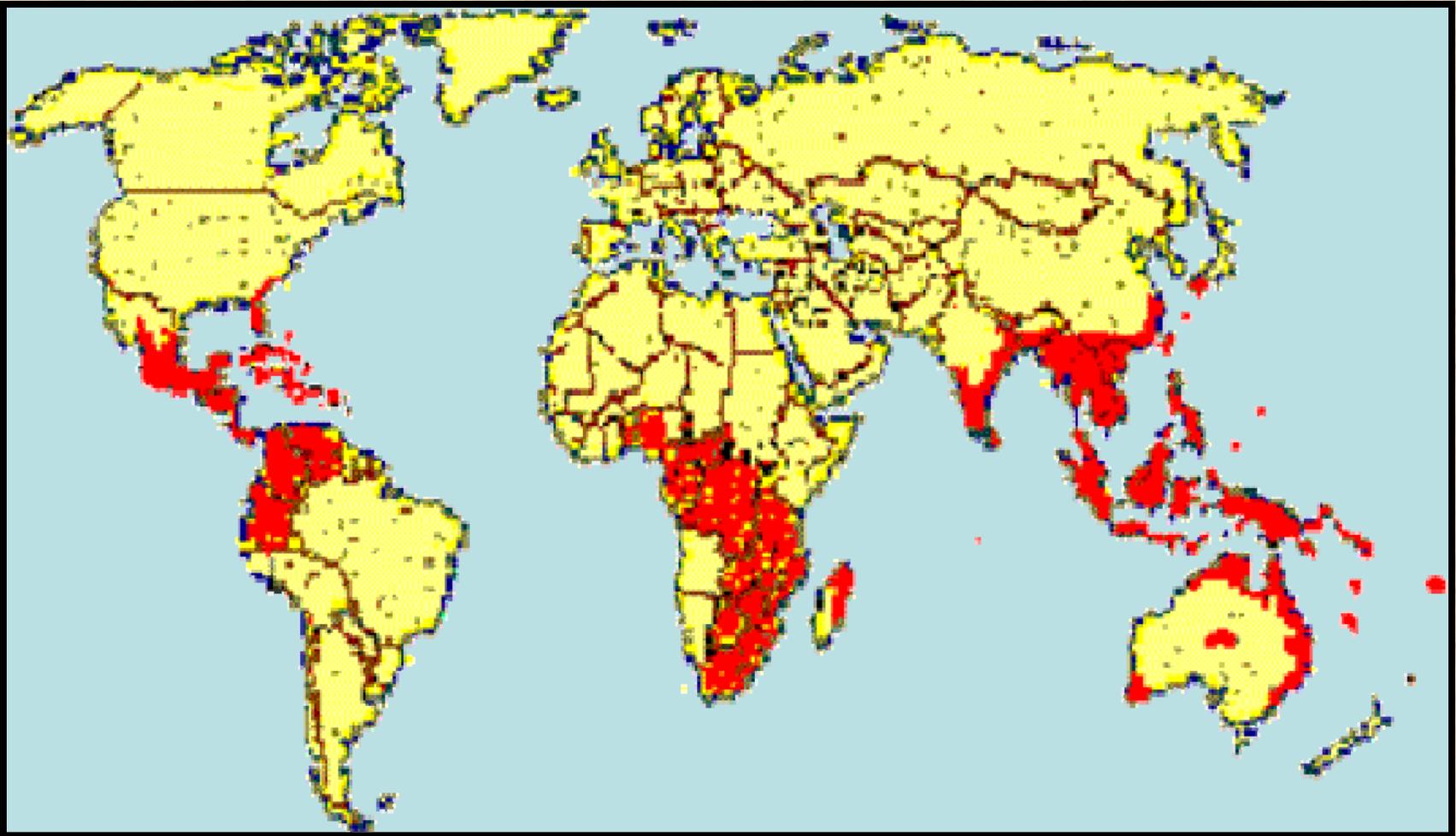




## Cycads Appeared on Earth 250 MYA

- Reached their greatest abundance and diversity during the Jurassic
- Declined sharply during the Cretaceous radiation of the angiosperms.

# Global Distribution of Cycads is Tropical



# Mexican Cycads

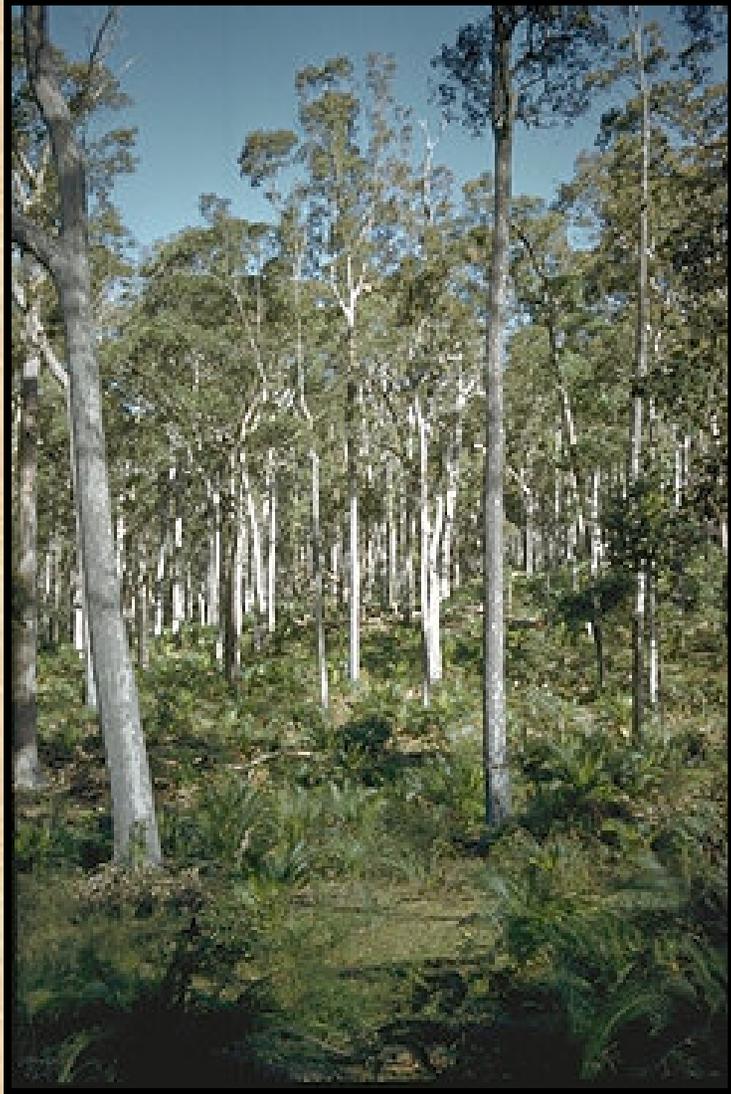


*Dioon*



*Ceratozamia*

# Australian Cycads



*Macrozamia*



*Macrozamia*

# African Cycads

late cone at tip of the single lateral branch. B, ovoid cones of *Encephalartos umbeluziensis*. [From Dyer, *Cactus Succulent Jour.* 44:209, 1972.]



*Encephalartos*



*Stangeria*

# Only Cycad Native to the US



*Zamia pumila*



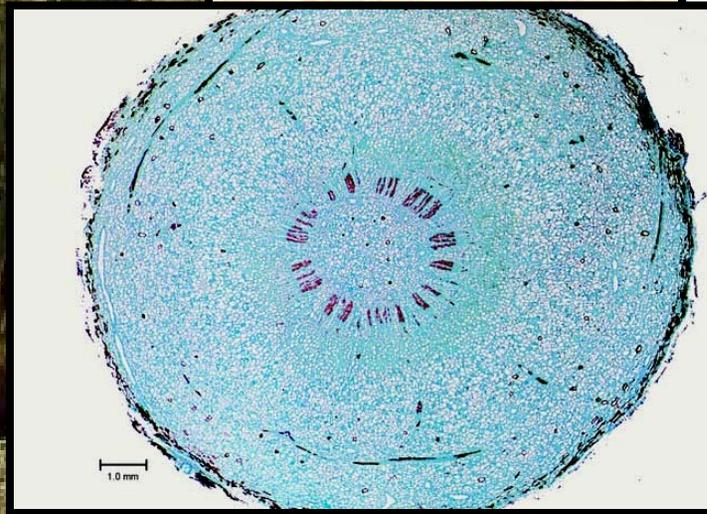
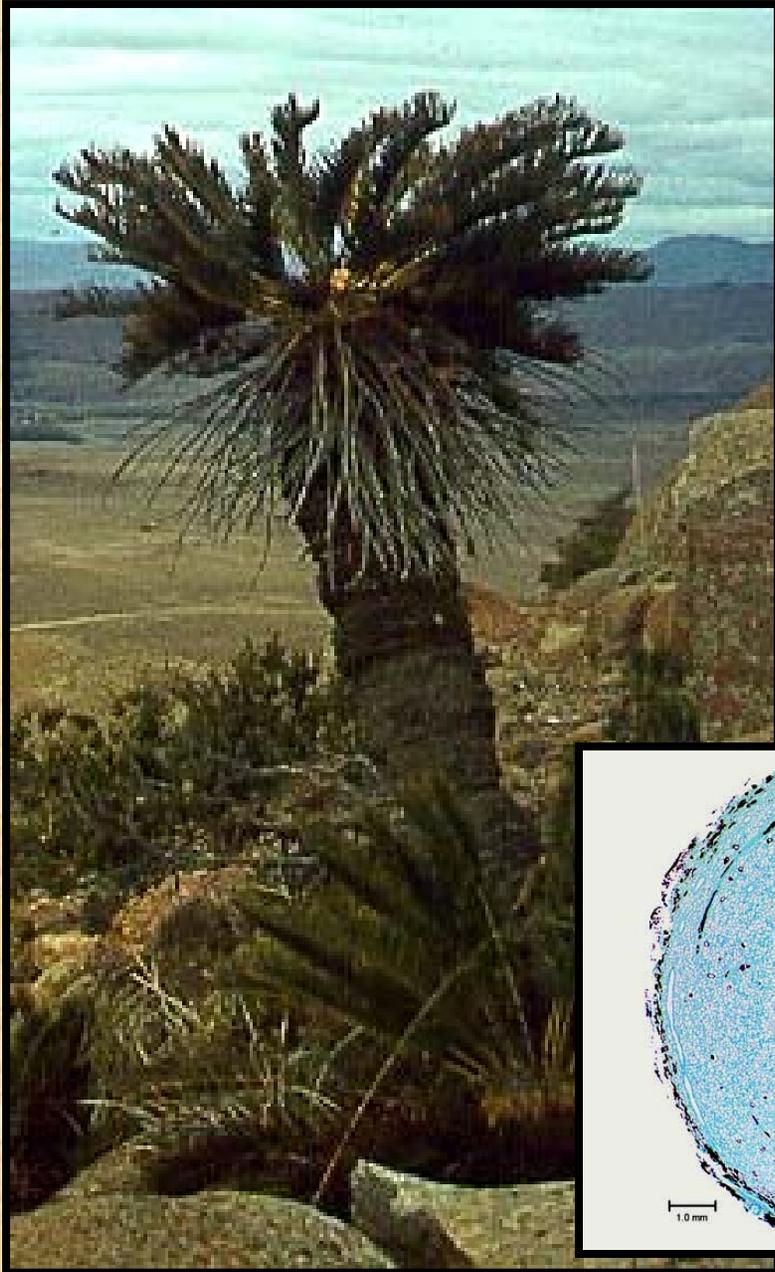
# Cycads – Vegetative Characteristics



*Encephalartos* in Africa

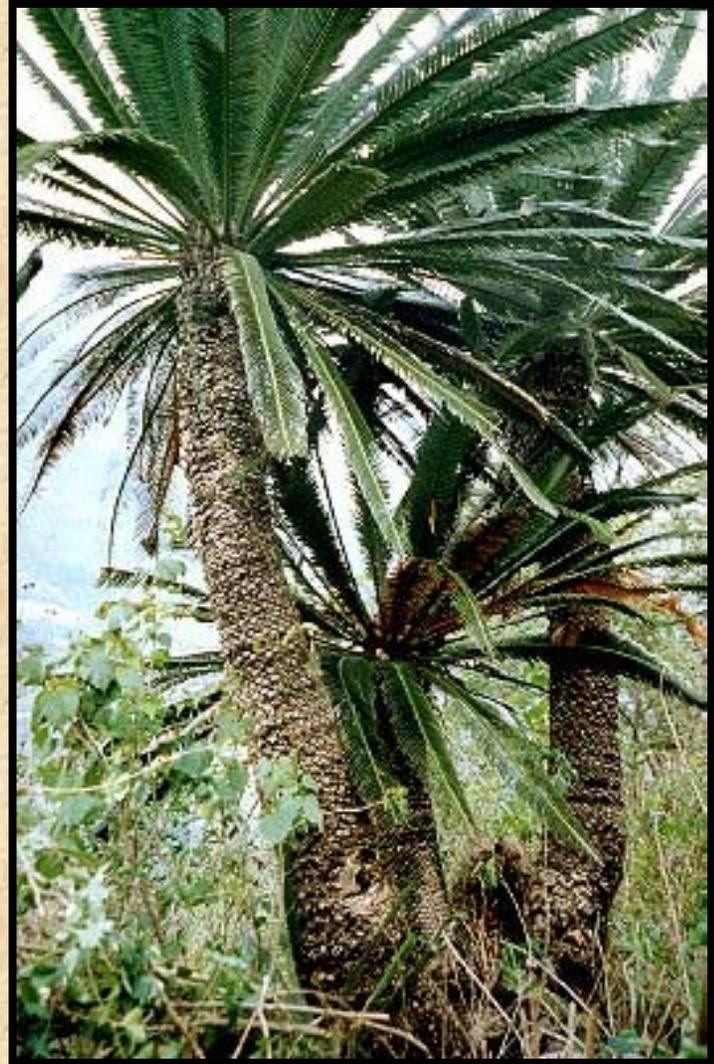
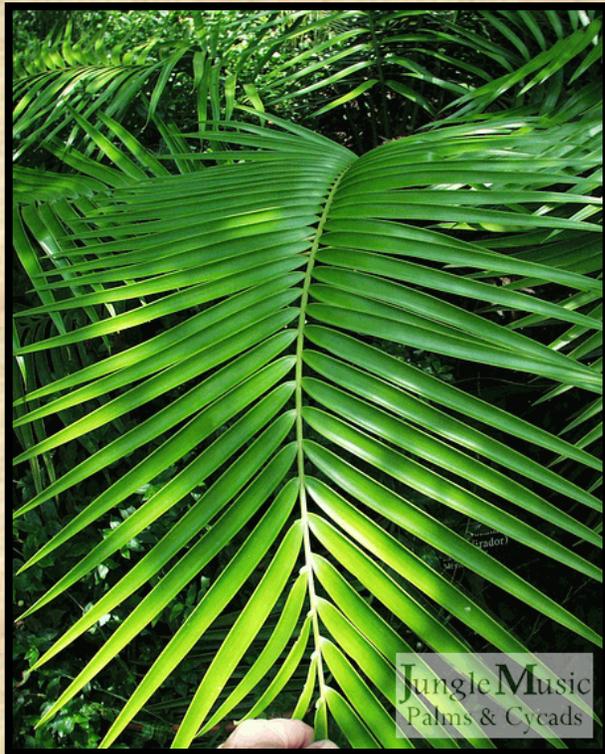
# Cycad Stems

- Columnar
- Little branching
- Not very woody



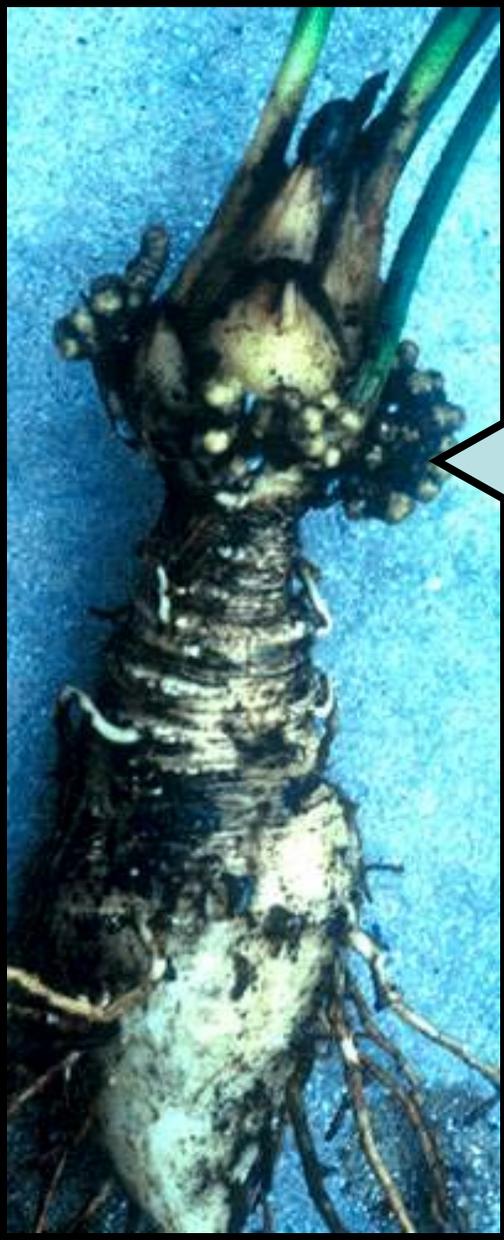
# Cycad Leaves

- Produced in crowns at tip of stem
- Pinnately compound

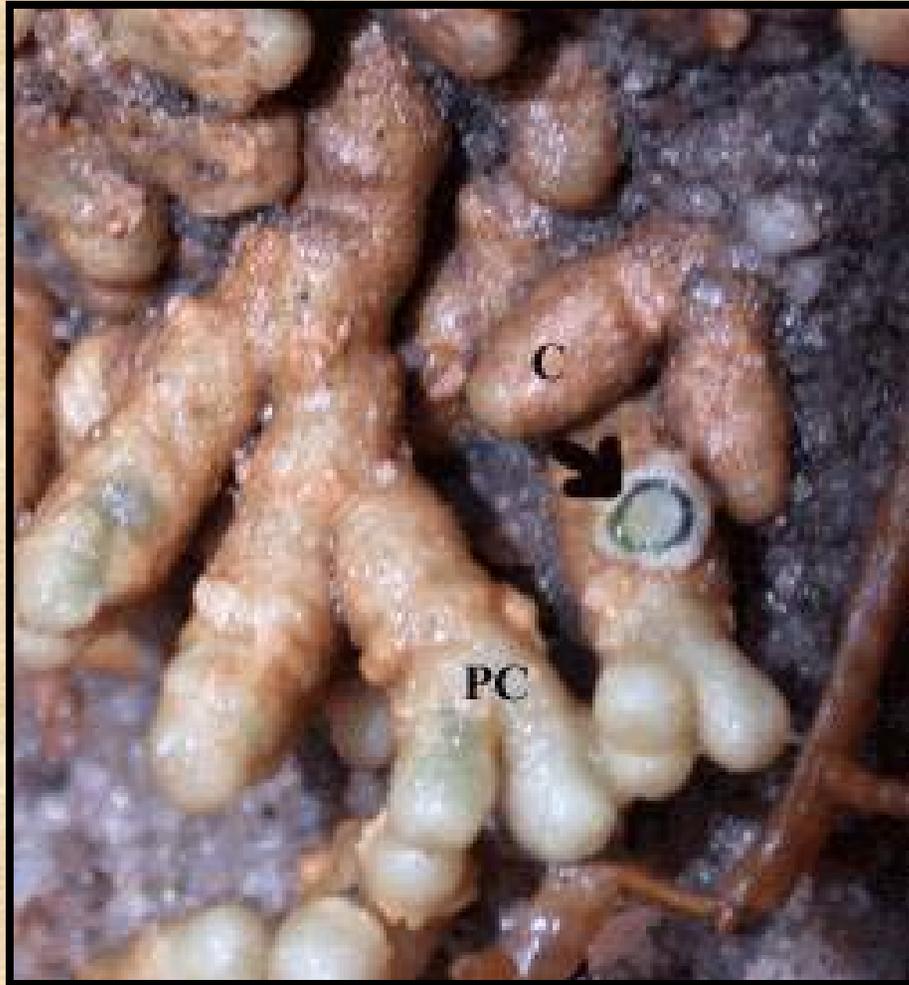


Certain roots in Cycads grow toward the soil surface

Corralloid  
Roots



# A Closer Look at Coralloid Roots



- Grow upward near soil surface
- Branch to form masses
- Root cortex inhabited by Cyanobacteria (carry out nitrogen fixation)



# Cycads – Reproductive Structures



# Cycads produce pollen and seeds in cones

- Cones develop at apex of stem



# All Cycads are Dioecious



Pollen Cone

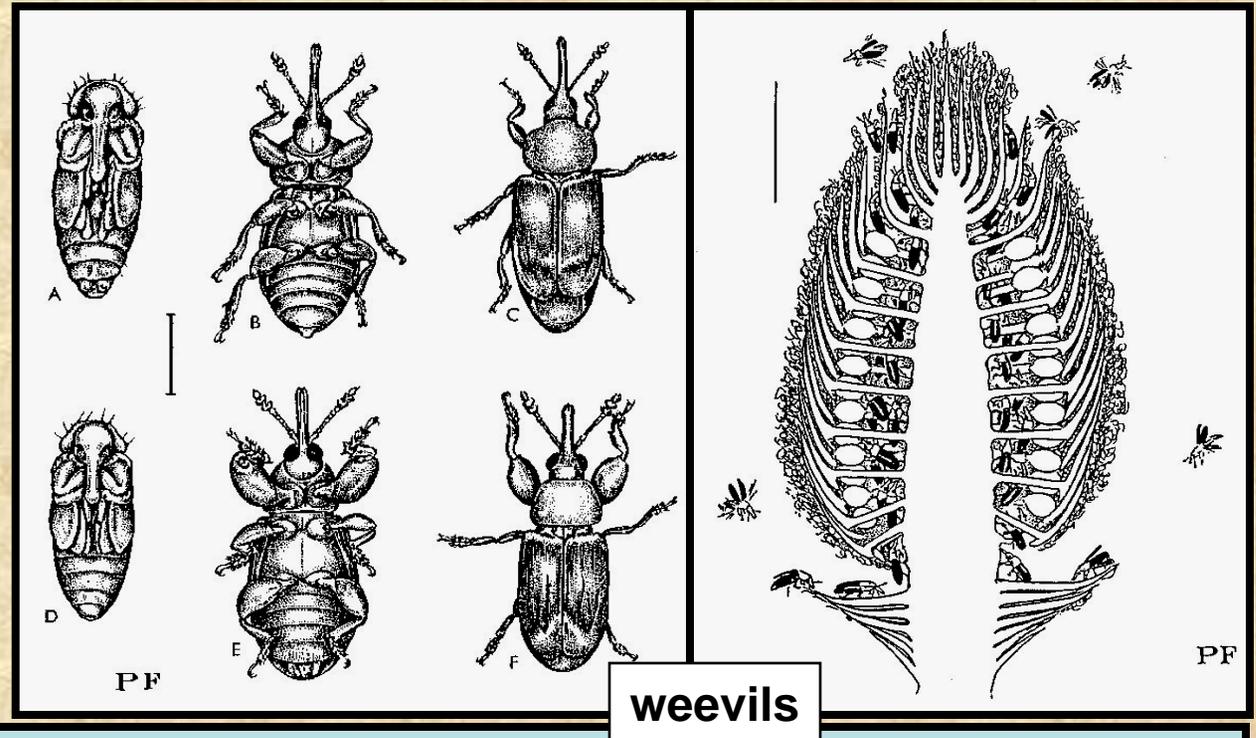
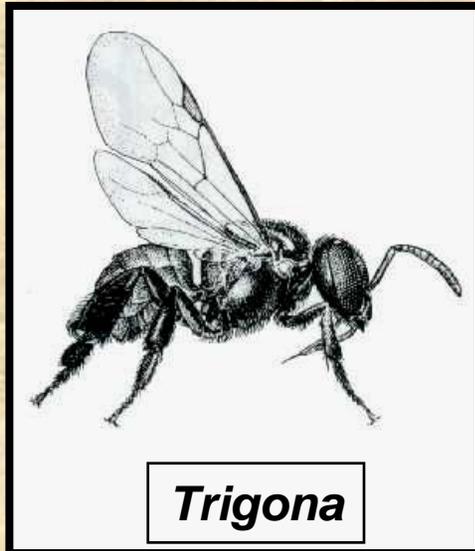
- Individual plants produce either pollen cones or seed cones



Seed Cone

*Cycas revoluta*

# Many Cycads are Pollinated by Insects



- Only a few cycad species studied
- Weevils and oldest known bee genus (*Trigona*)
- Usually pollinators mate and lay eggs within female cone
- All cones except *Stangeria* produce heat. Thought to volatilize pollinator attractants
- Hence insect pollination may predate flowering plants

# Ginkgo – The Maiden Hair Tree

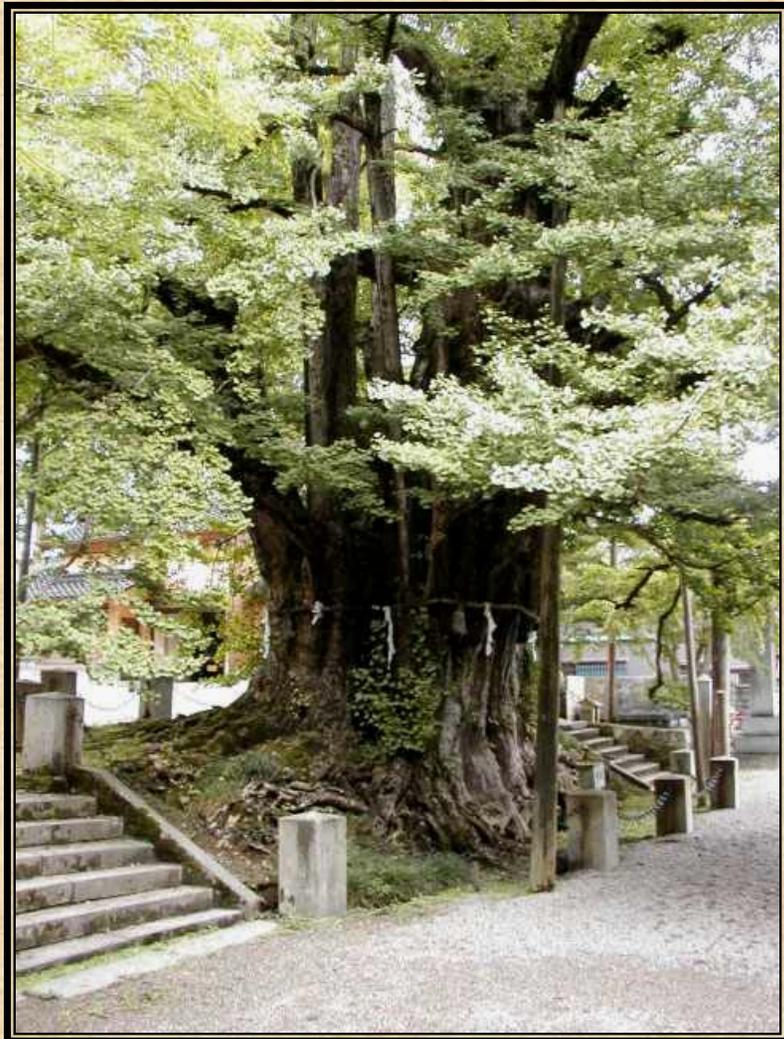


# Ginkgo was a common forest tree in the geological past

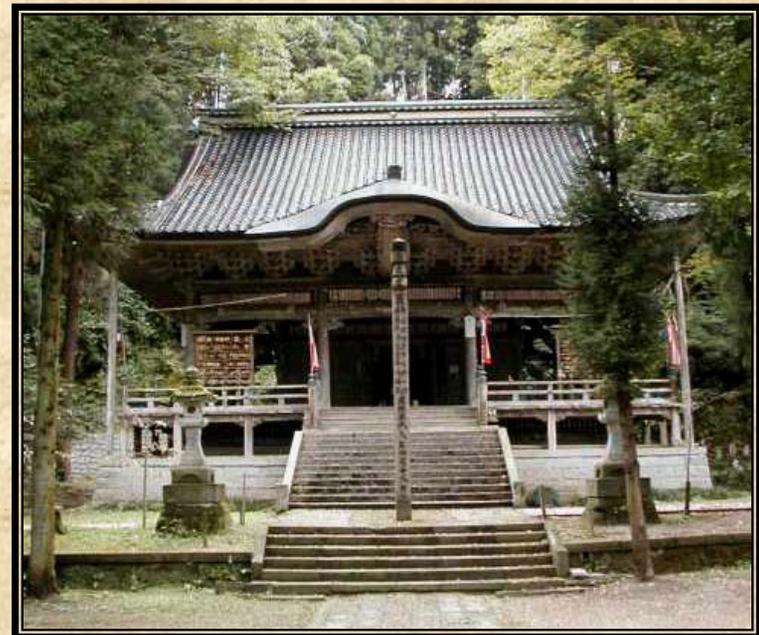


- Today represented by a single species
- Once occurred in North American Forests
- Presently occurs naturally only in China

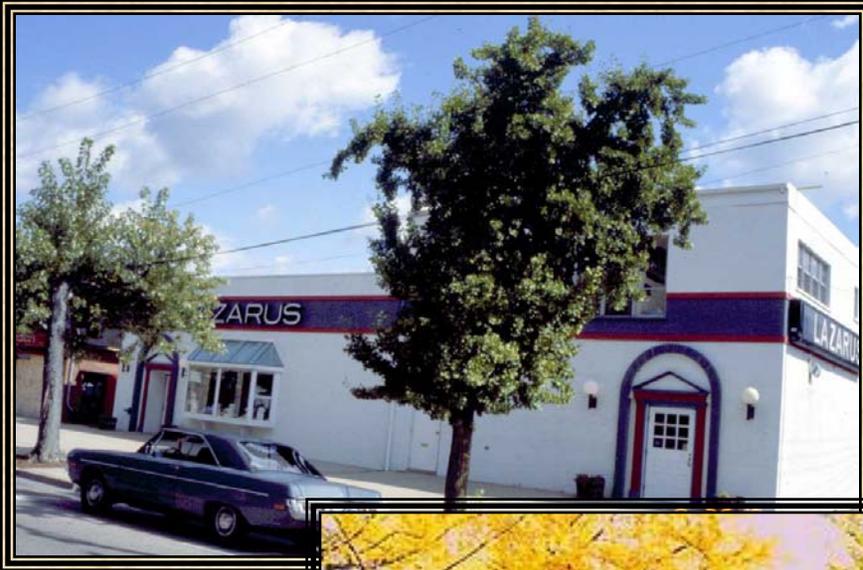
# Present Distribution of *Ginkgo biloba*



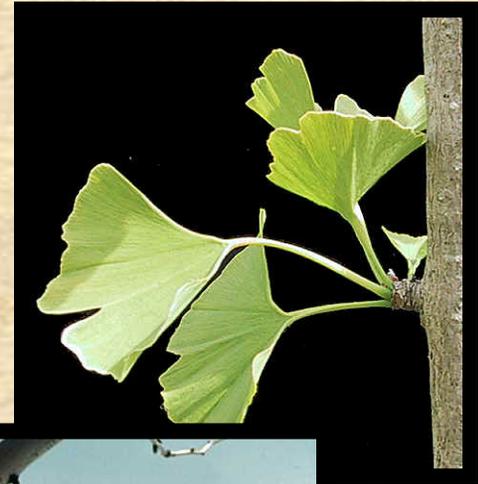
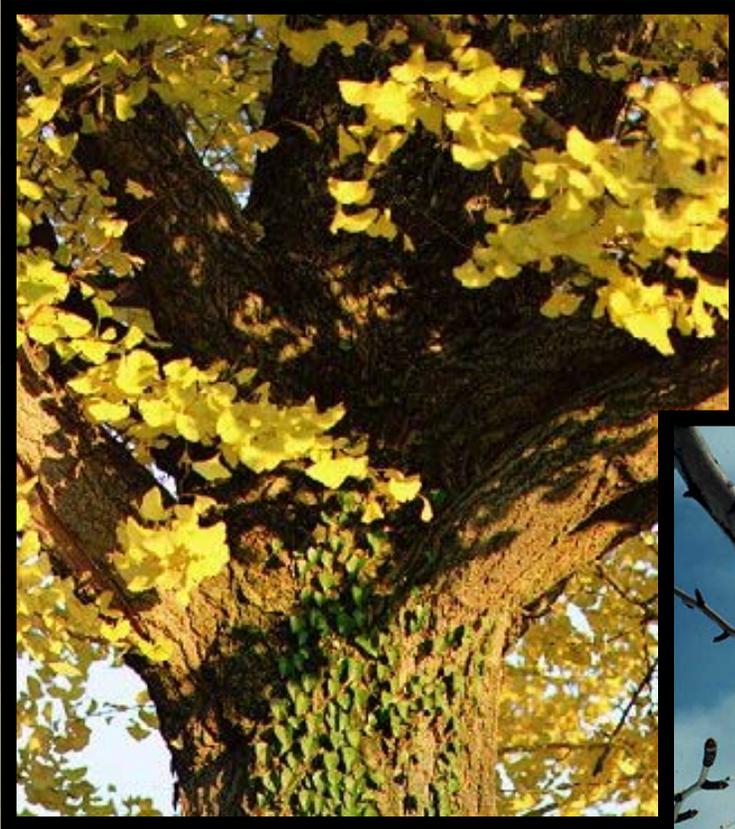
- “Natural” trees may actually be plants cultivated at ancient Monasteries



# Ginkgo is also widely cultivated



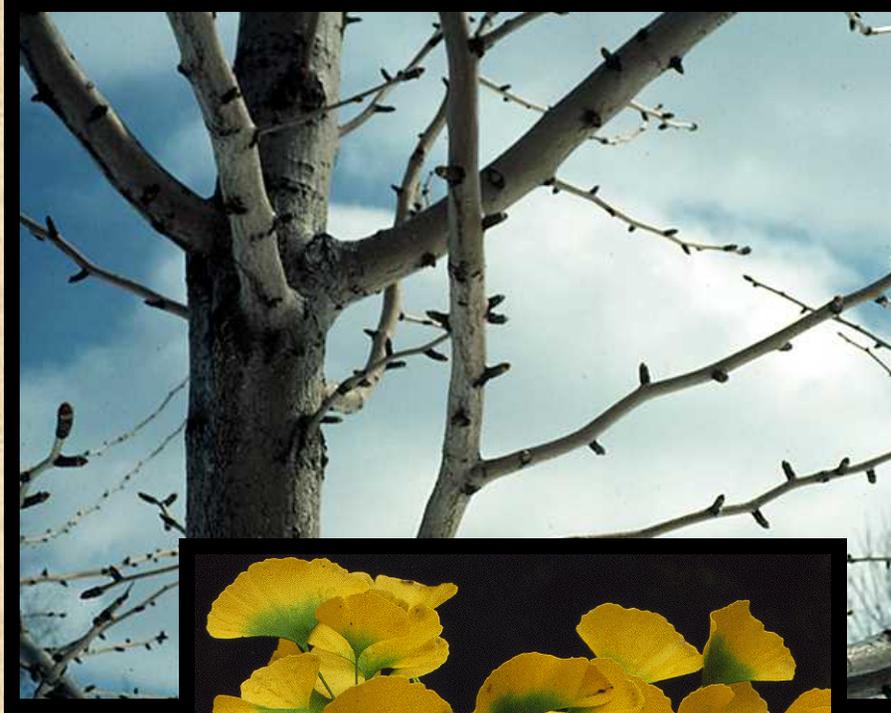
# Ginkgo – Vegetative Characteristics



# Ginkgo is Deciduous



# Ginkgo is Deciduous



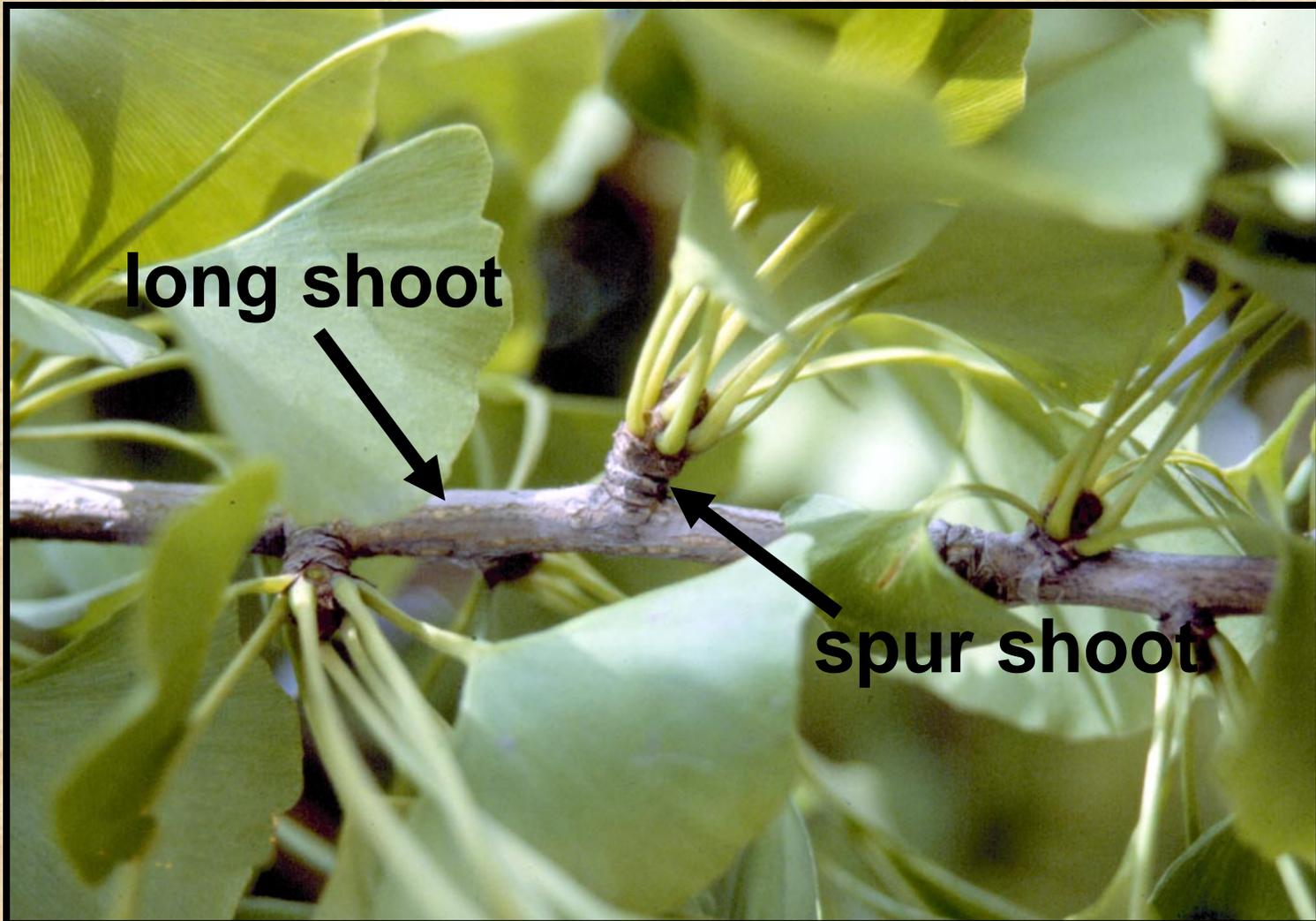
# Ginkgo Stems



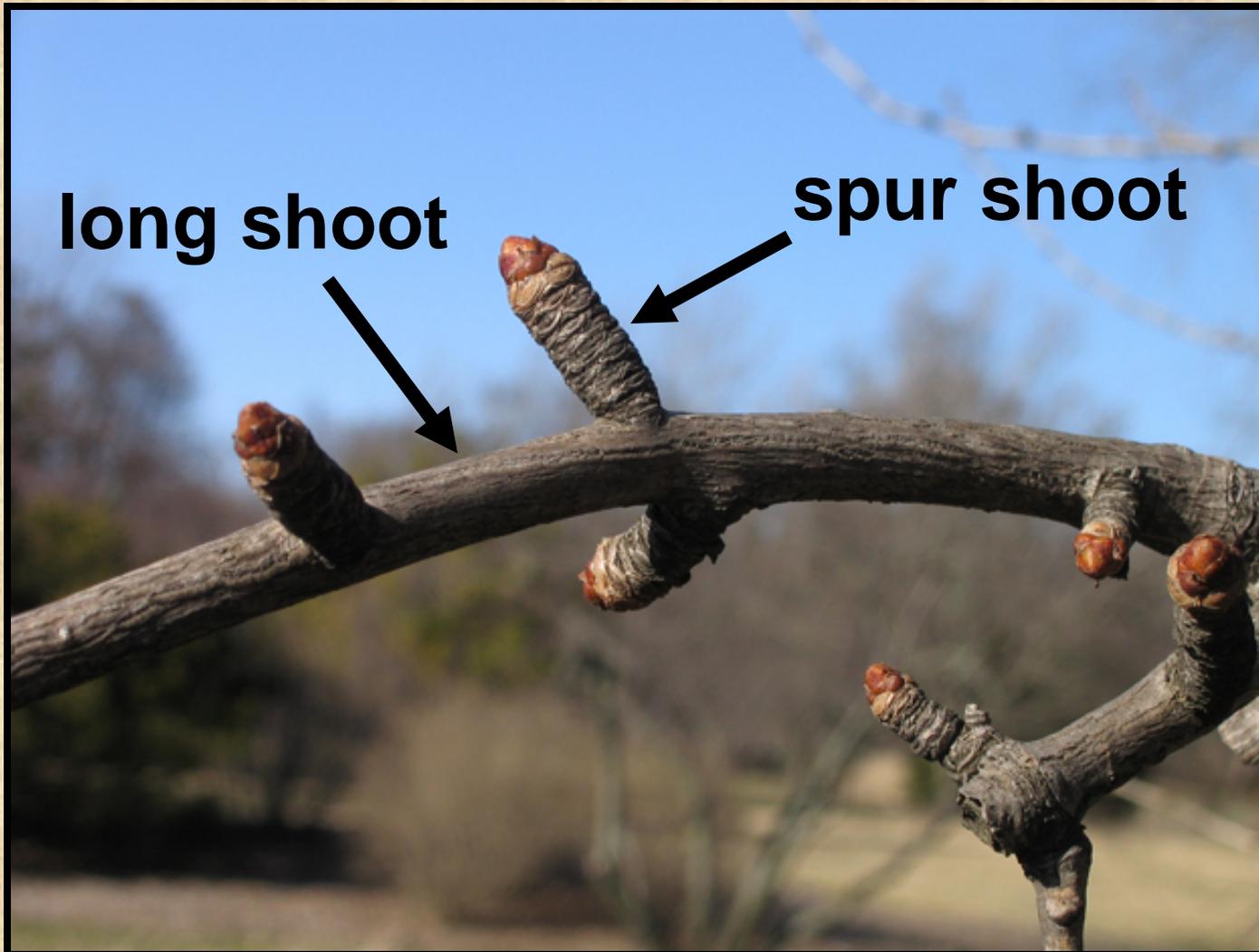
- Extensive branching
- Very woody



# Ginkgo Stems

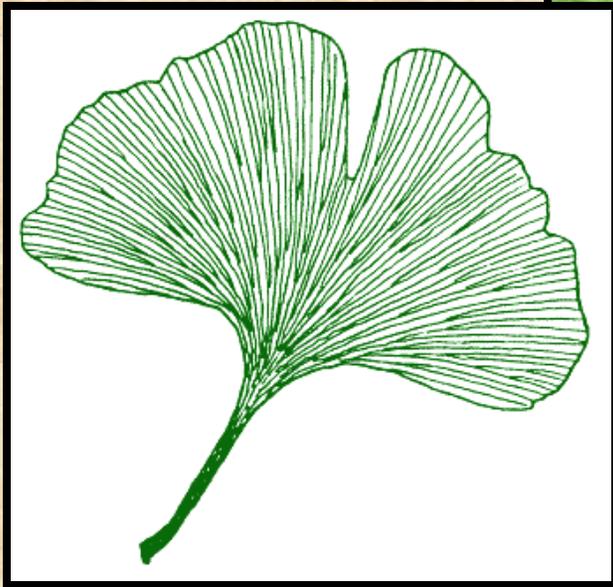


# Ginkgo Stems



# Ginkgo Leaves

- Fan shaped
- Dichotomous branching veins

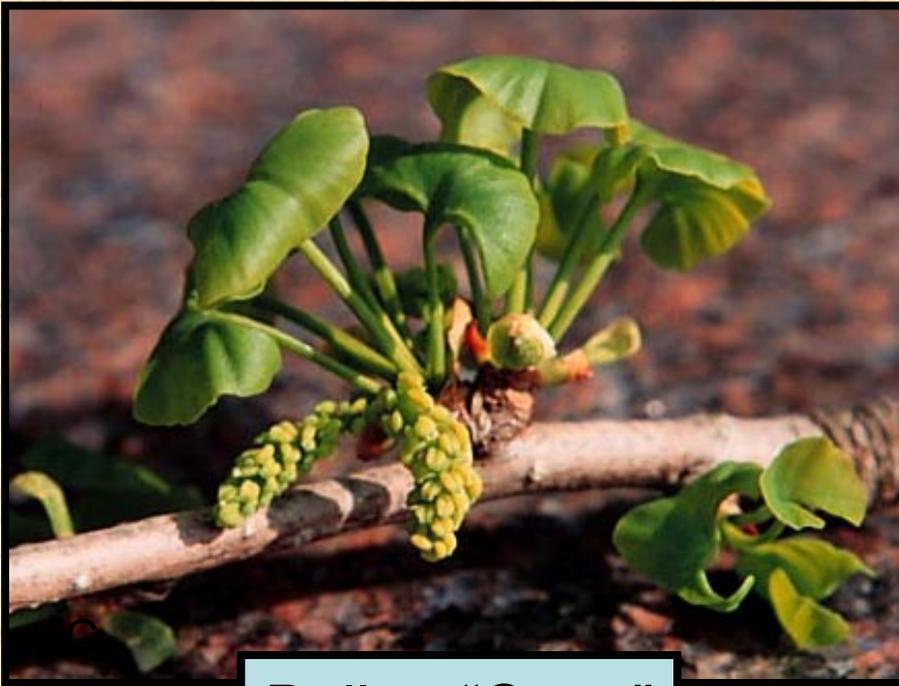


Leaf shape ranges from entire to bilobed



# All Ginkgo trees are Dioecious

- Individual plants produce either pollen “cones” or seed “cones”
- Produced on spur shoots



Pollen “Cone”



Seed “Cone”

# Ginkgo produces a seed with a fleshy seed coat



- Seed Coat contains Butyric Acid
- Seed Coat is not edible



**FEMALE GINKGO TREES TO BE SPRAYED**  
*WITHIN TWO WEEKS FOR*  
**FRUIT CONTROL**

*DELAYS MAY BE DUE TO:*  
HIGH WINDS, POLLUTION ALERT, RAIN,  
EXTREME TEMPERATURE BELOW 35° F/ ABOVE 85° F

DEPARTMENT OF PUBLIC WORKS  
767-3532

Ginkgo seeds are edible when  
fleshy seed coat is removed



# Nutrition Facts

Serving Size 155g

## Amount Per Serving

**Calories** 172      Calories from Fat 21

## % Daily Value\*

**Total Fat** 3g      4%

Saturated Fat 0g      2%

**Cholesterol** 0mg      0%

**Sodium** 476mg      20%

**Total Carbohydrate** 34g      11%

Dietary Fiber 14g      58%

Sugars

**Protein** 4g

Vitamin A      10%

Vitamin C      24%

Calcium      1%

Iron      2%

\*Percent Daily Values are based on a 2,000 calorie diet.  
Your daily values may be higher or lower depending on your calorie needs.

NutritionData.com



# Taro with Ginkgo Seed



# Ginkgo biloba leaves are a popular herbal remedy

- Slow the progression of Alzheimer's symptoms
- Relieve depression, anxiety, headaches, ringing in the ears (tinnitus), and dizziness
- Reduce macular degeneration and control cataracts
- Optimize brain power



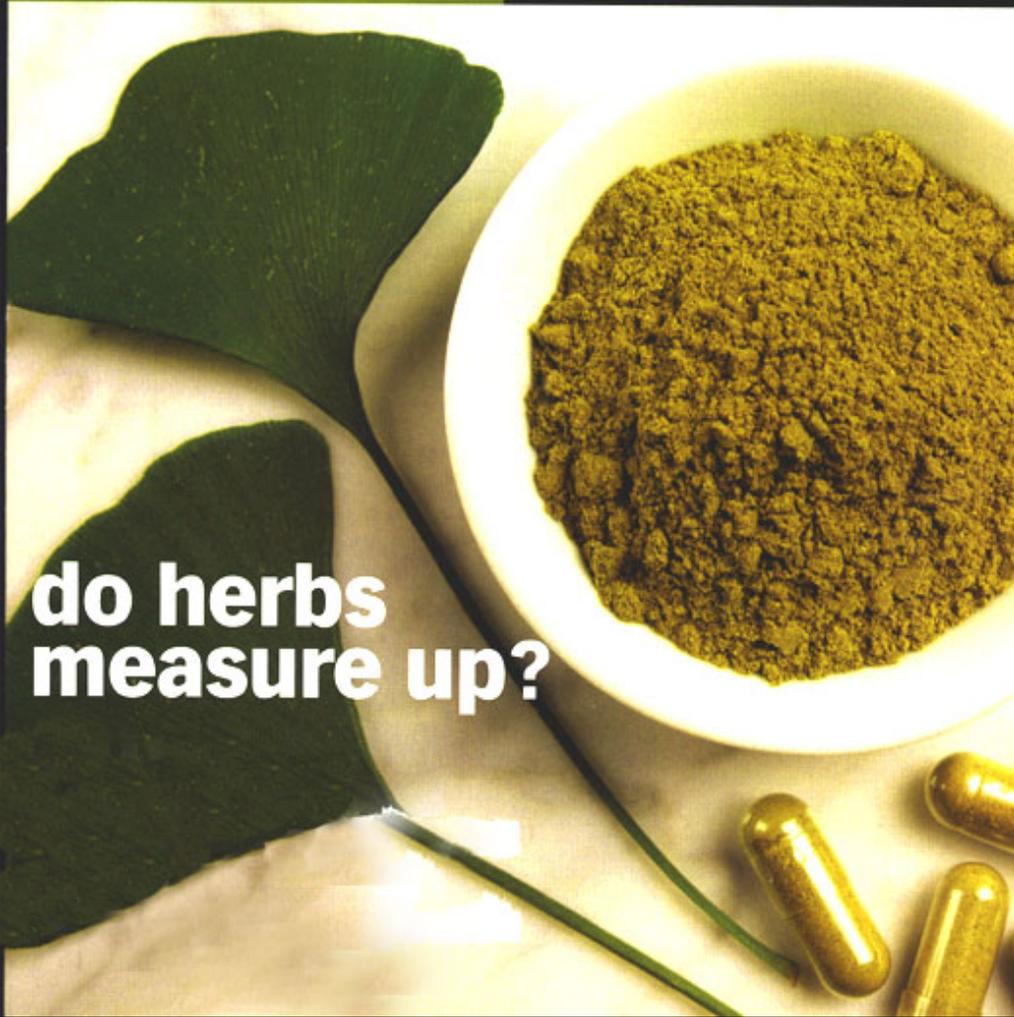
# SCIENCE NEWS

THE WEEKLY NEWSMAGAZINE OF SCIENCE

JUNE 7, 2003 PAGES 353-368 VOL. 163, NO. 23

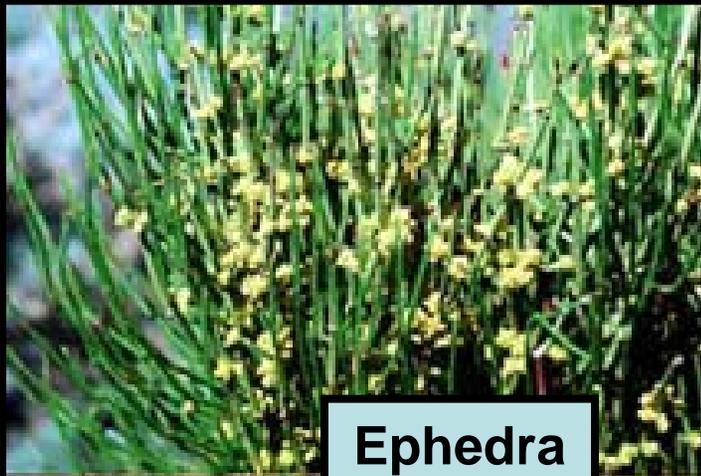
better danger detectors  
ears regrow sensory cells  
tale of the "gecko tape"  
can nonstick make you sick?

[www.sciencenews.org](http://www.sciencenews.org)



**do herbs  
measure up?**

# The Gnetophytes



**Ephedra**



**Gnetum**

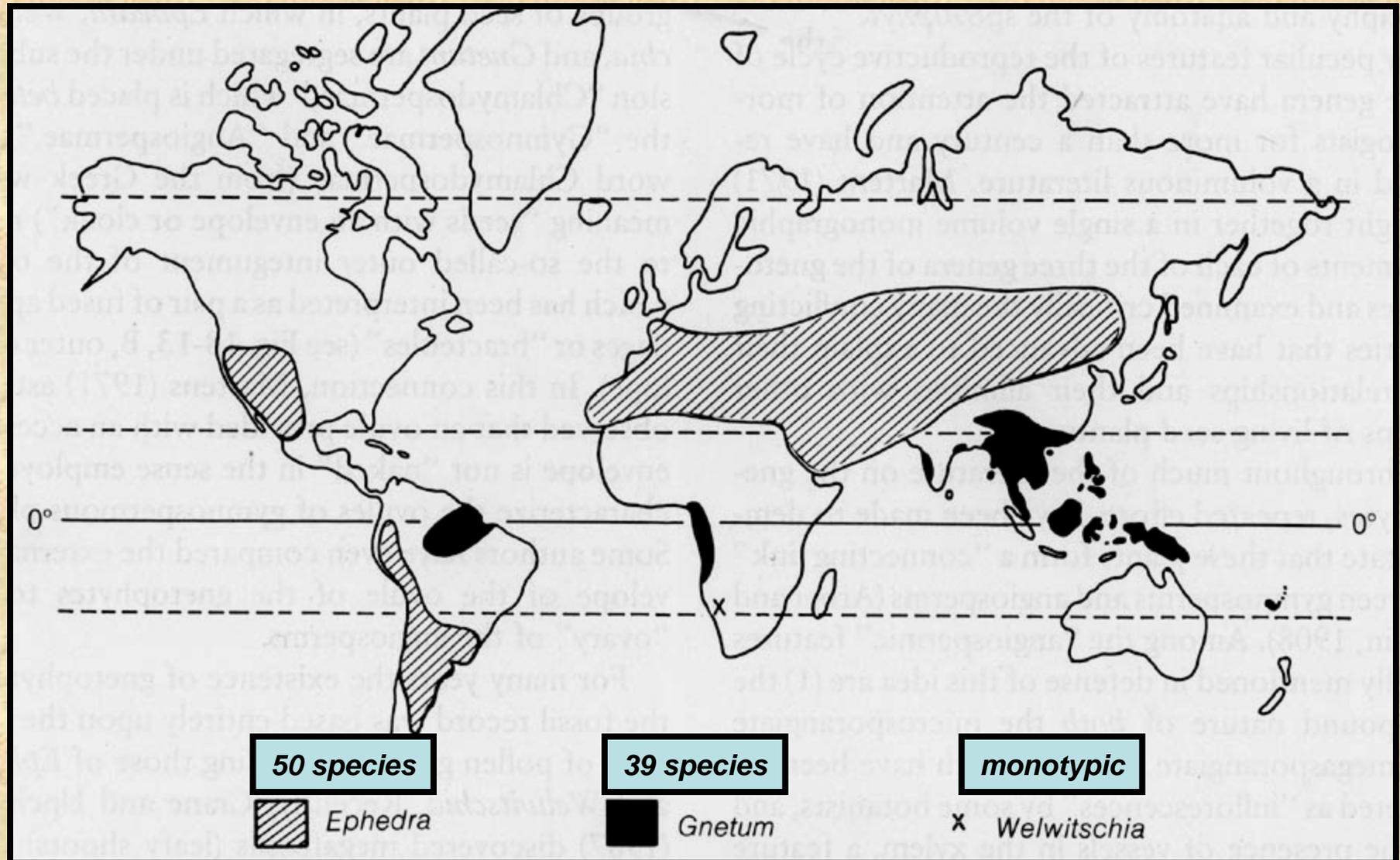


**Welwitschia**

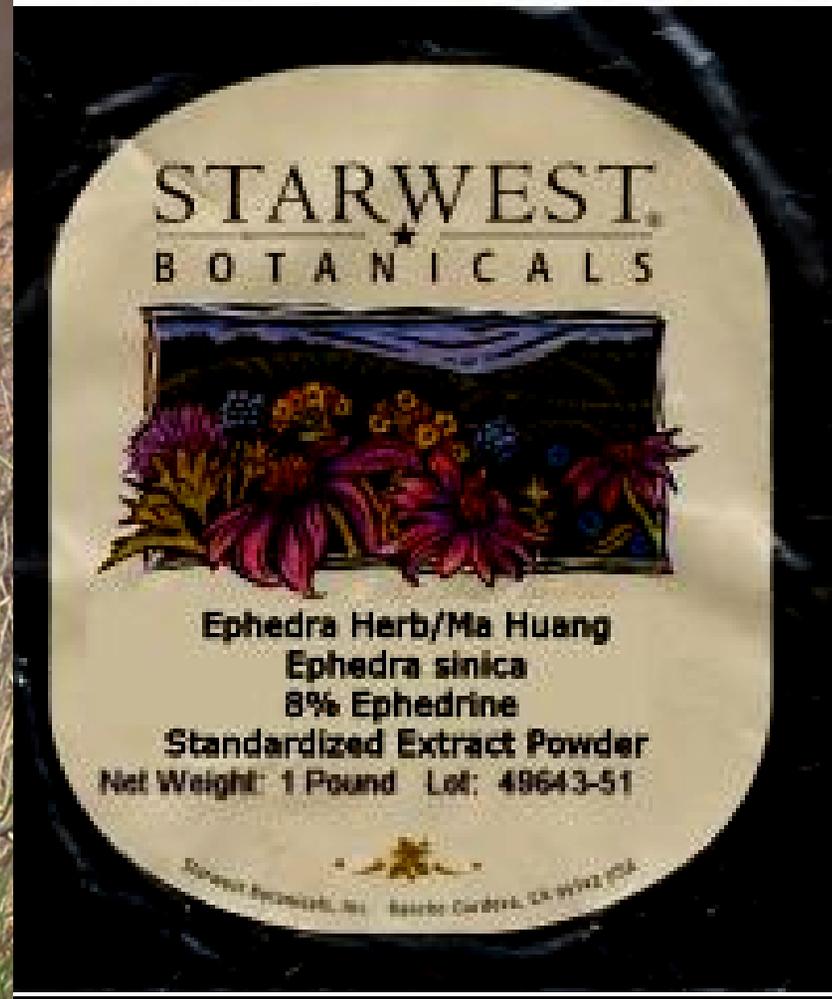
*Ephedra* is a desert shrub



# *Ephedra* is distributed in arid regions of the world



# *Ephedra* contains Ephedrine



<http://www.anephedraattorneyforyou.com/>

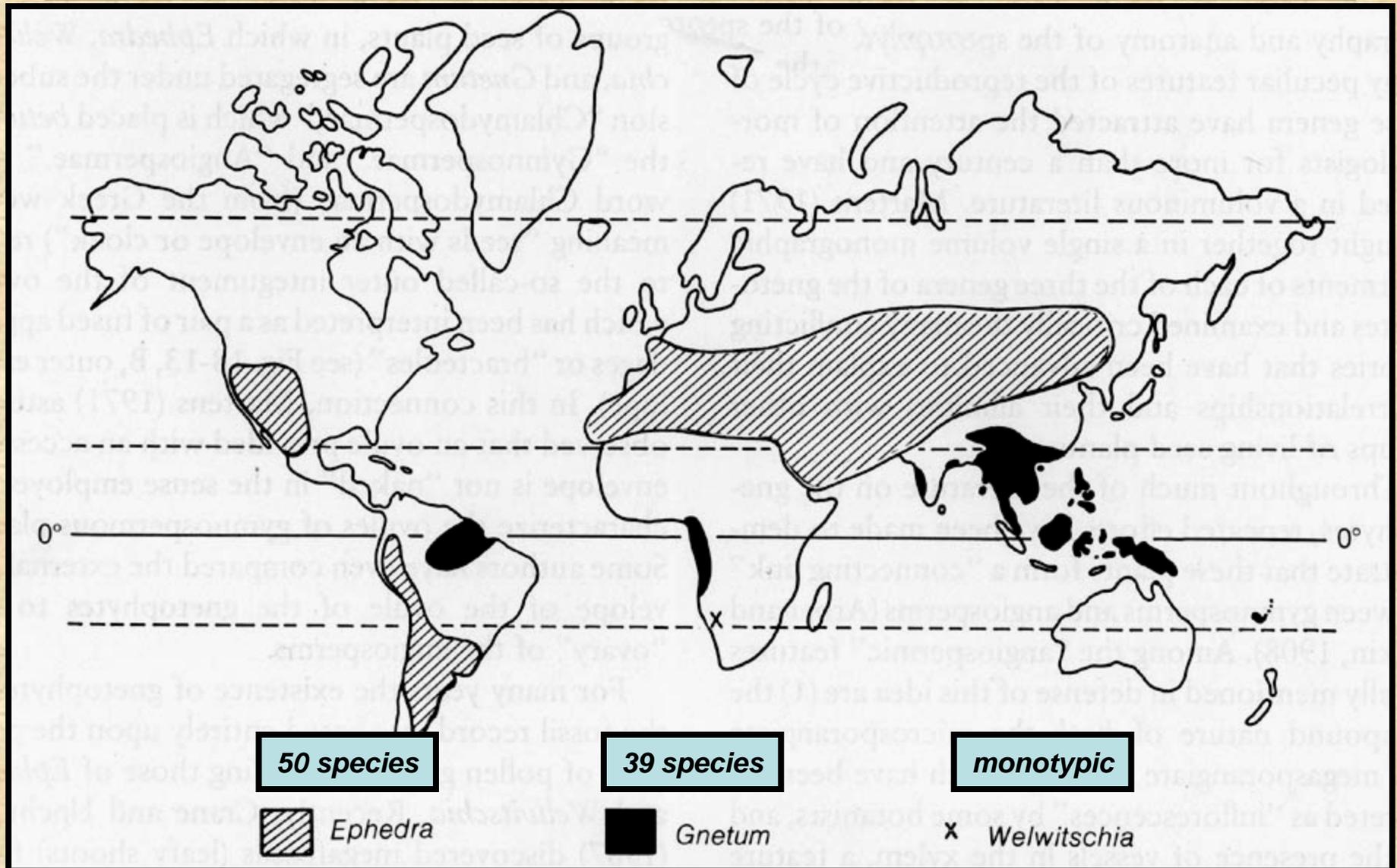
# Pseudoephedrine is a Synthetic Version of Ephedrine



*Gnetum* is a  
tropical vine or  
small tree



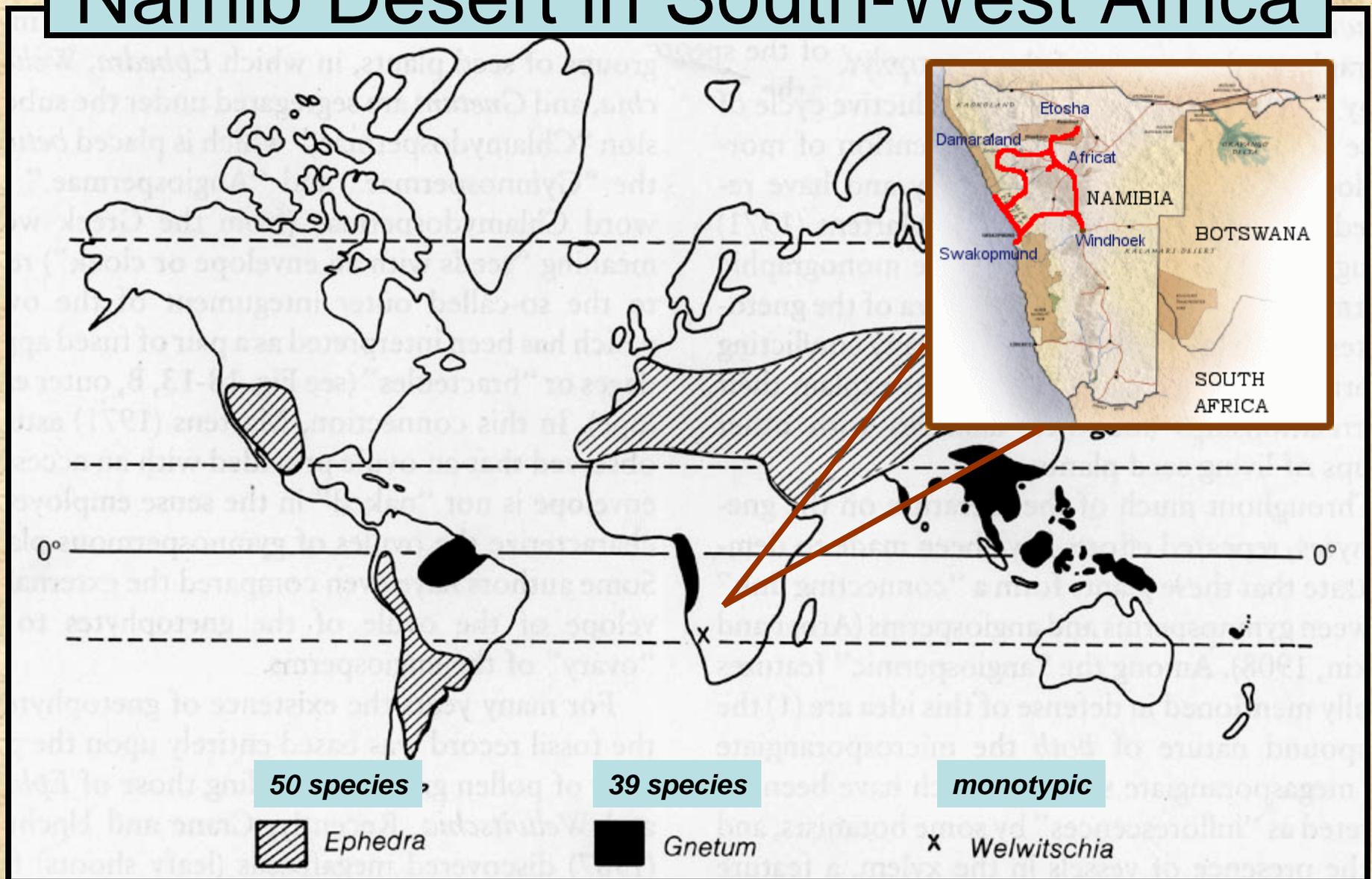
# *Gnetum* occurs in the tropics

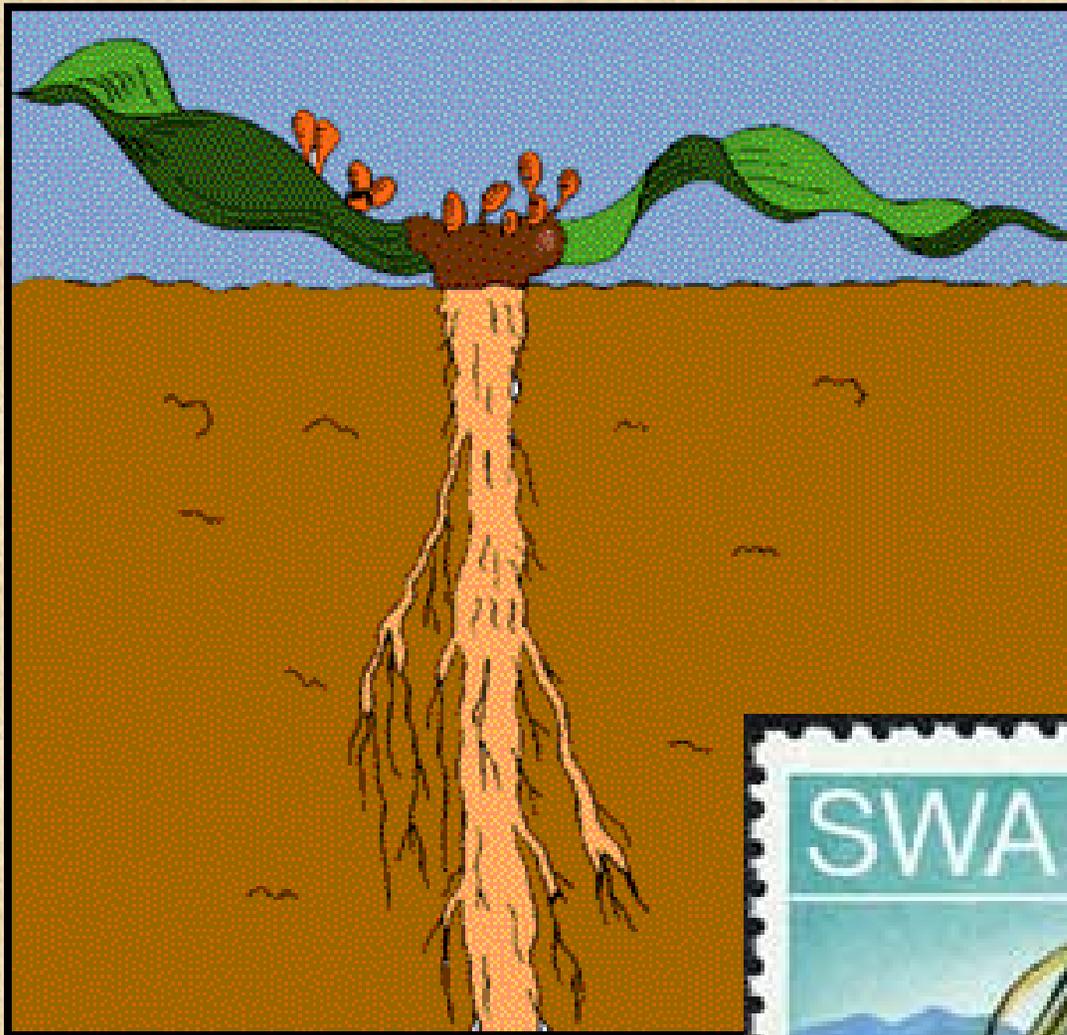


Welwitschia is a bizarre plant of an extremely arid environment

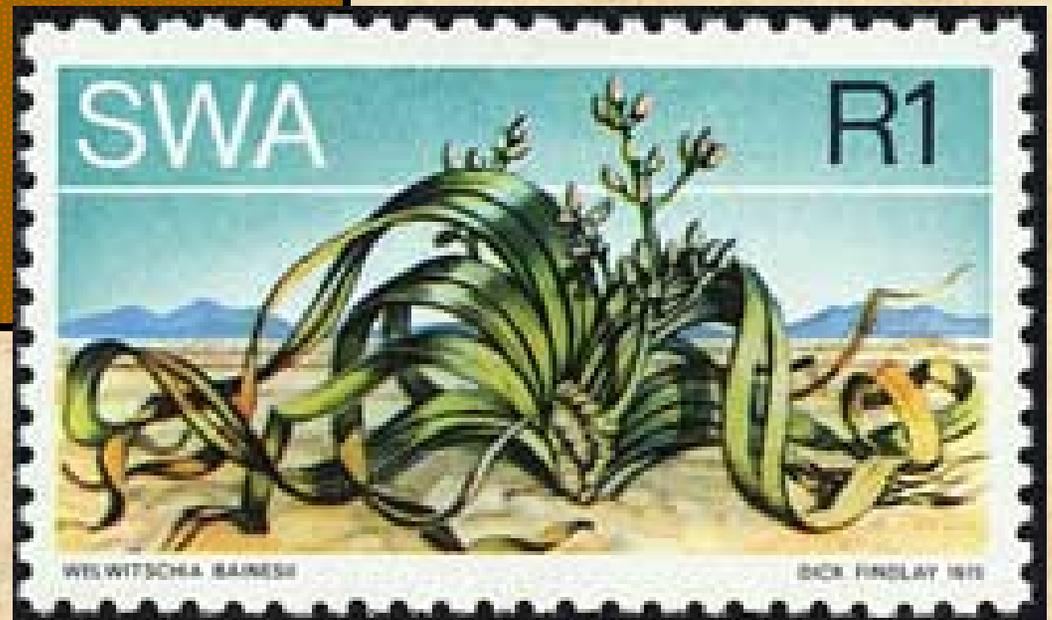


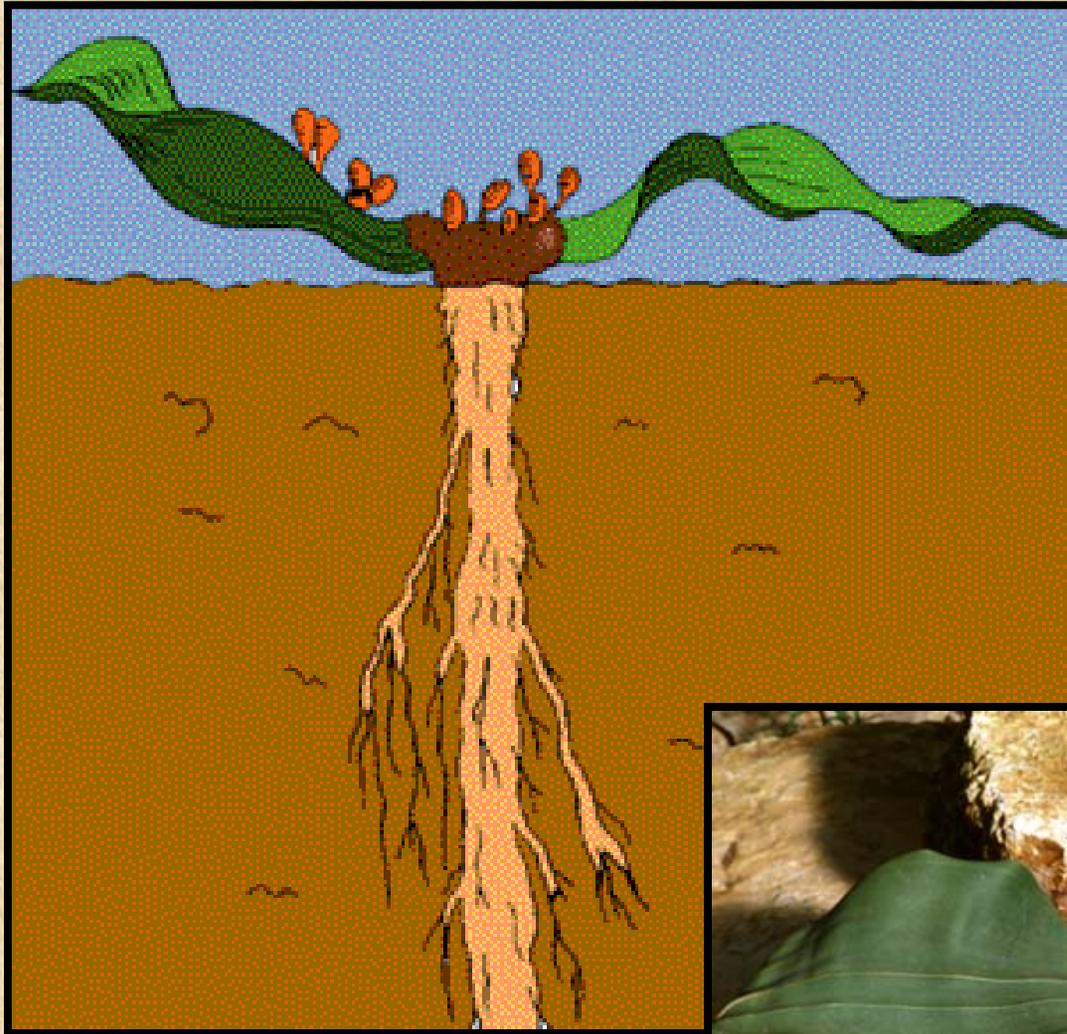
# *Welwitschia* occurs only in the Namib Desert in South-West Africa





*Welwitschia*  
forms a  
short stem  
and deep  
tap root





*Welwitschia*  
produces  
only two  
adult leaves





*Welwitschia*  
leaves grow  
from the base  
– leaves fray  
as they grow

