

OPHIOGLOSSOPSIDA ORDERS



OPHIOGLOSSALES
PSILOTALES

OPHIOGLOSSOPSIDA
ORDERS



**EXTANT
ORDER**

OPHIOGLOSSALES

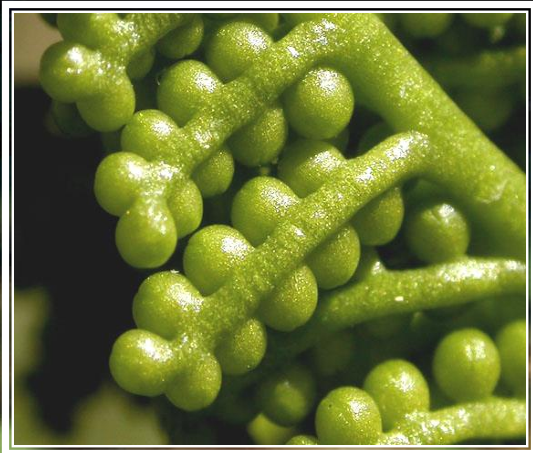
**EXTANT
ORDER**



COMMON NAME



GRAPE-FERNS



GRAPE-FERNS

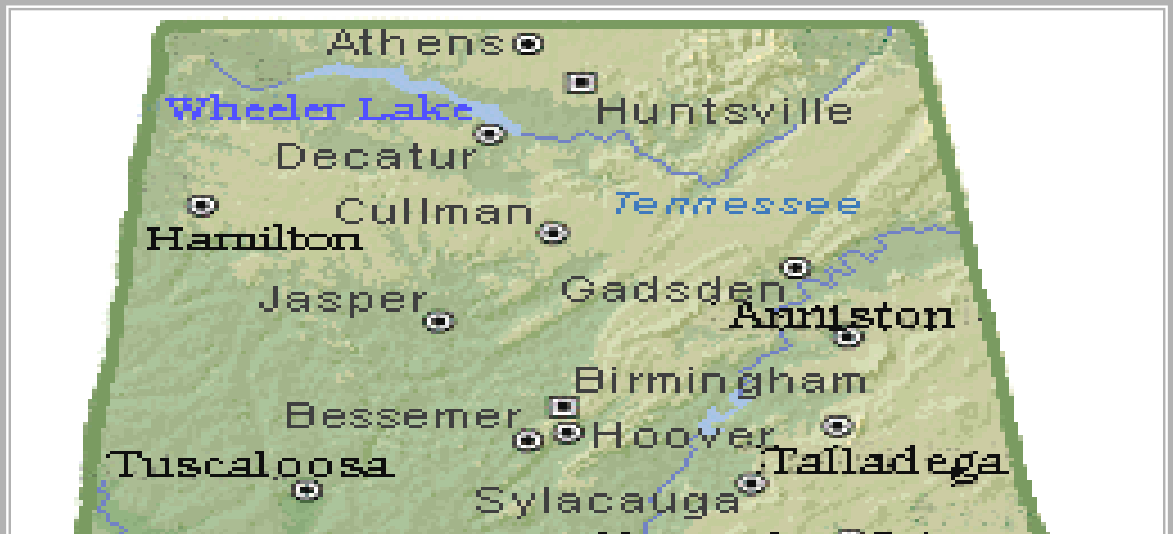


DIVERSITY



~100 SPECIES

EARTH



~7 SPECIES





REPRESENTATIVE GENERA



OPHIOGLOSSUM



BOTRYCHIUM



DISTRIBUTION

T

TROPICAL

EARTH



TEMPERATE

EARTH

A high-resolution satellite image of the Earth from space, showing the curvature of the planet, blue oceans, white clouds, and brownish-green landmasses. The image is centered on the Atlantic Ocean, with parts of North and South America visible.

DOMINATELY TEMPERATE

EARTH



HABITAT



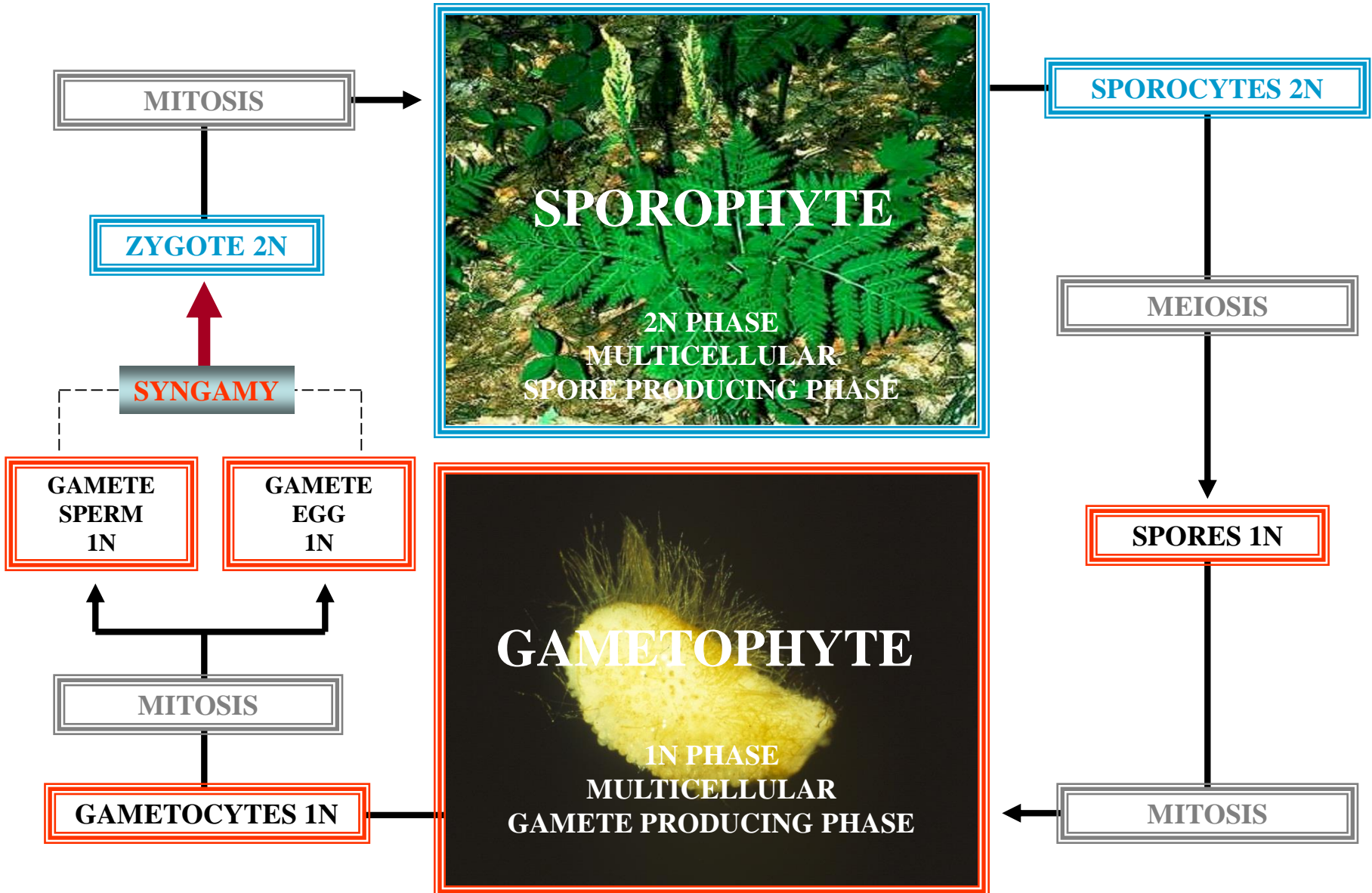
ALABAMA FOREST



GENERAL CHARACTERS

OPHIOGLOSSALES

LIFE CYCLE





SPOROPHYTE CHARACTERS

KARYOTYPE

KARYOTYPE

OPHIOGLOSSALES KARYOTYPE



CHROMOSOME CHARACTERS

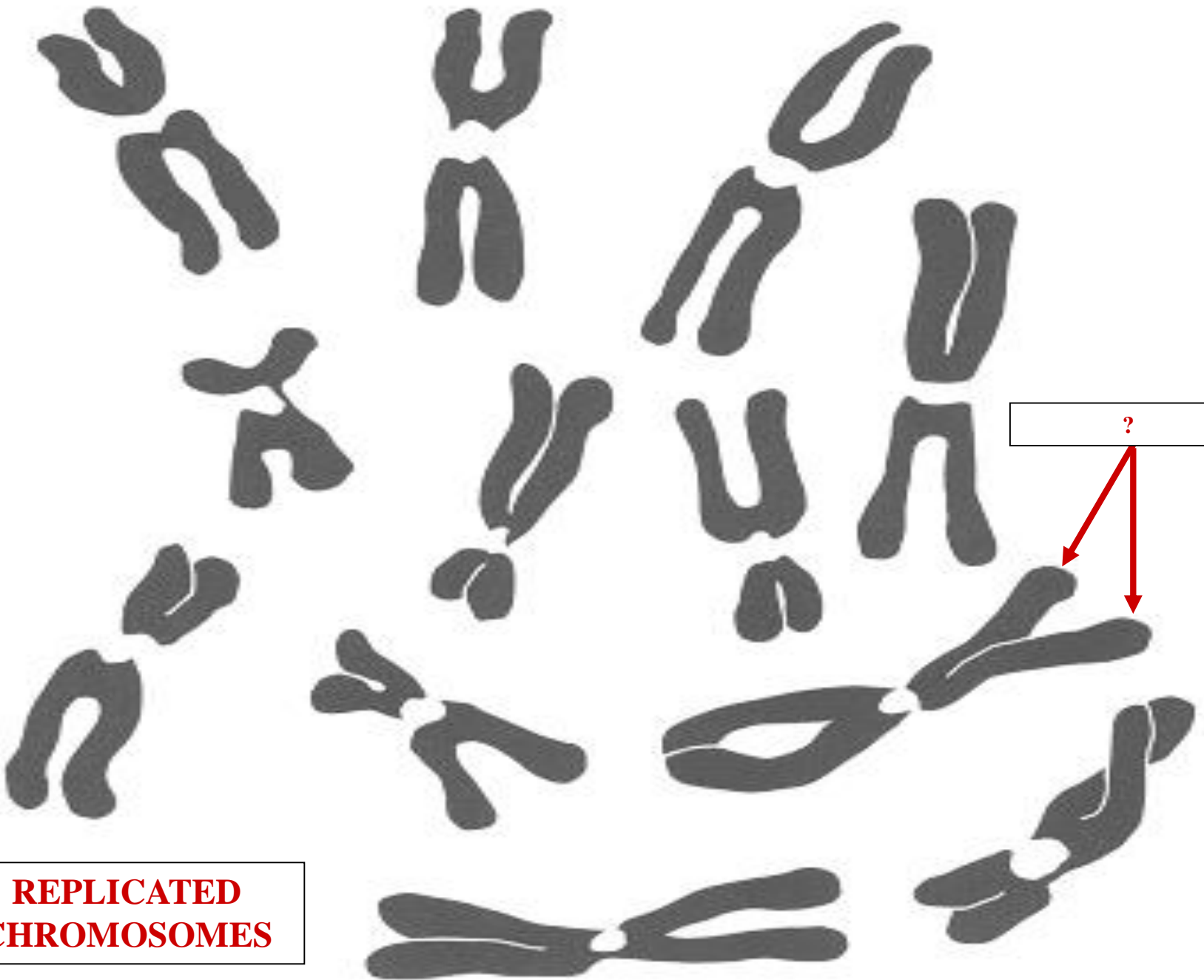
OPHIOGLOSSALES KARYOTYPE



CHROMOSOMES



**REPLICATED
CHROMOSOMES**



**REPLICATED
CHROMOSOMES**

?

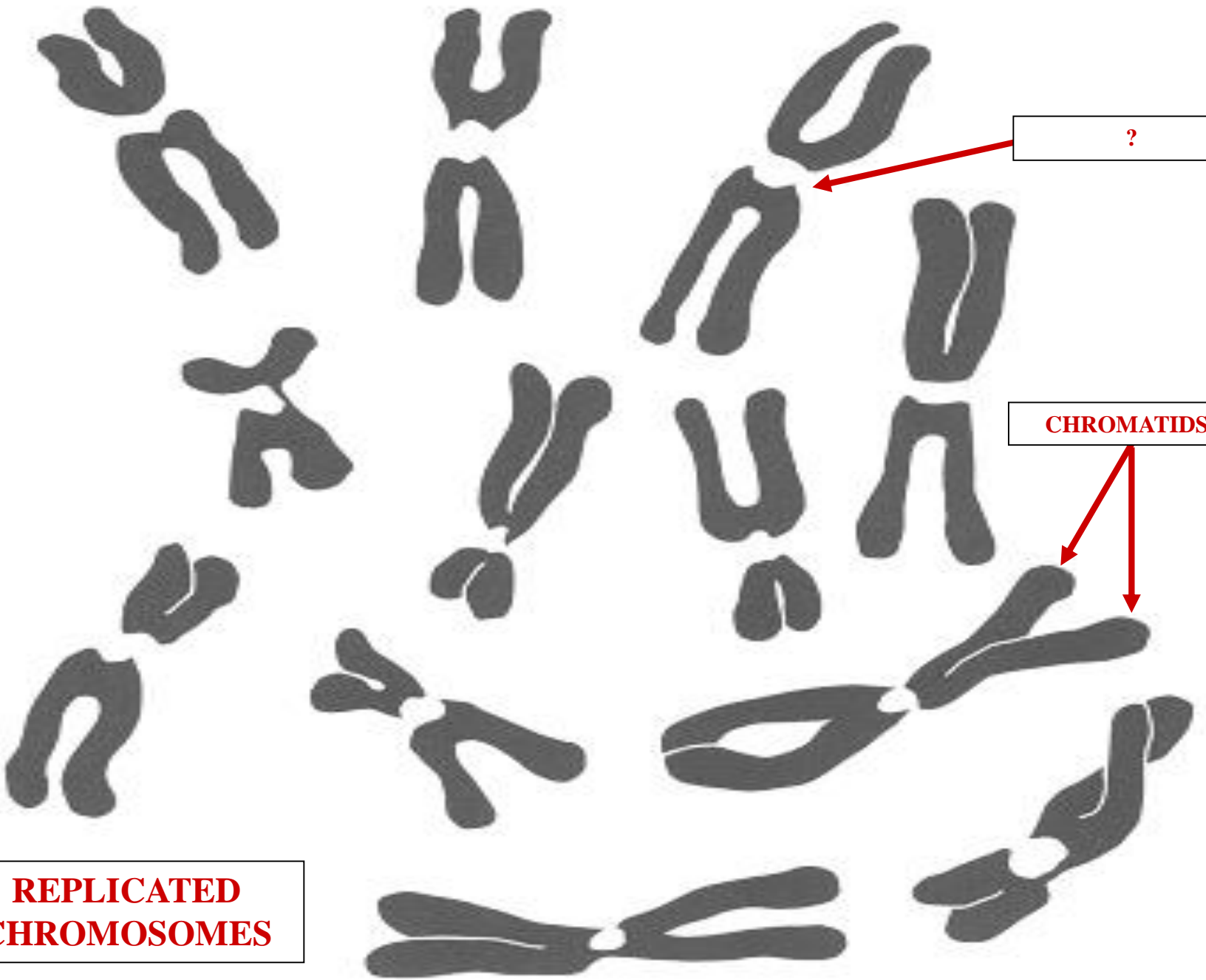
CHROMATIDS



REPLICATED
CHROMOSOMES



C



?

CHROMATIDS

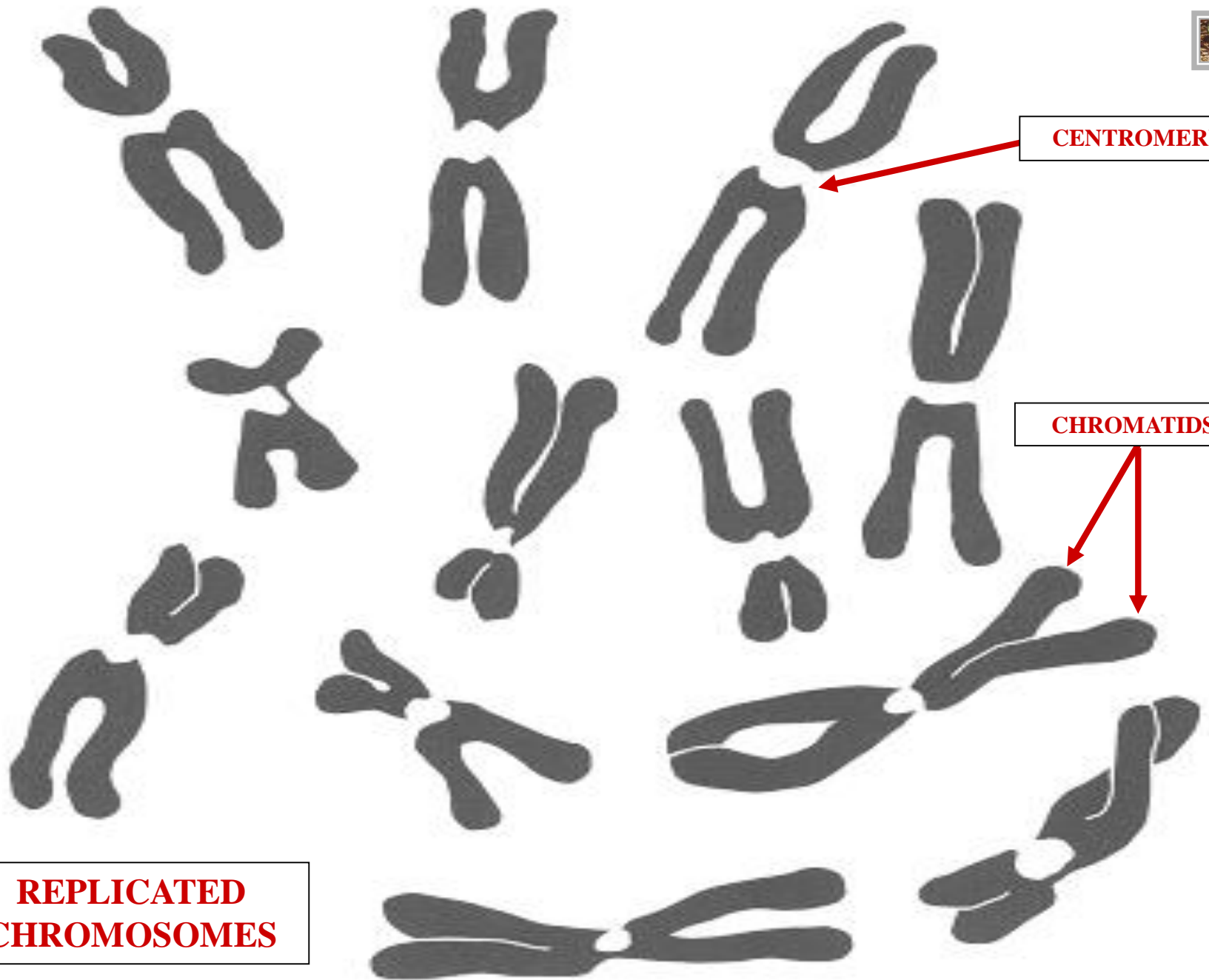
**REPLICATED
CHROMOSOMES**



CENTROMERE

CHROMATIDS

**REPLICATED
CHROMOSOMES**



#

HIGHEST KNOWN
VASCULAR PLANT
CHROMOSOME
NUMBER

OPHIOGLOSSUM



$2N = 1260$

OPHIOGLOSSUM



HIGHEST KNOWN VASCULAR PLANT KARYOTYPES

OPHIOGLOSSUM

ROOT



**TRUE ROOTS
PRESENT**

VERTICAL RHIZOME

BOTRYCHIUM



**TRUE ROOTS
PRESENT
REDUCED**

VERTICAL RHIZOME

BOTRYCHIUM

**TRUE ROOT
REDUCED**

AB

**MATURATION
REGION**

**ELONGATION
REGION**

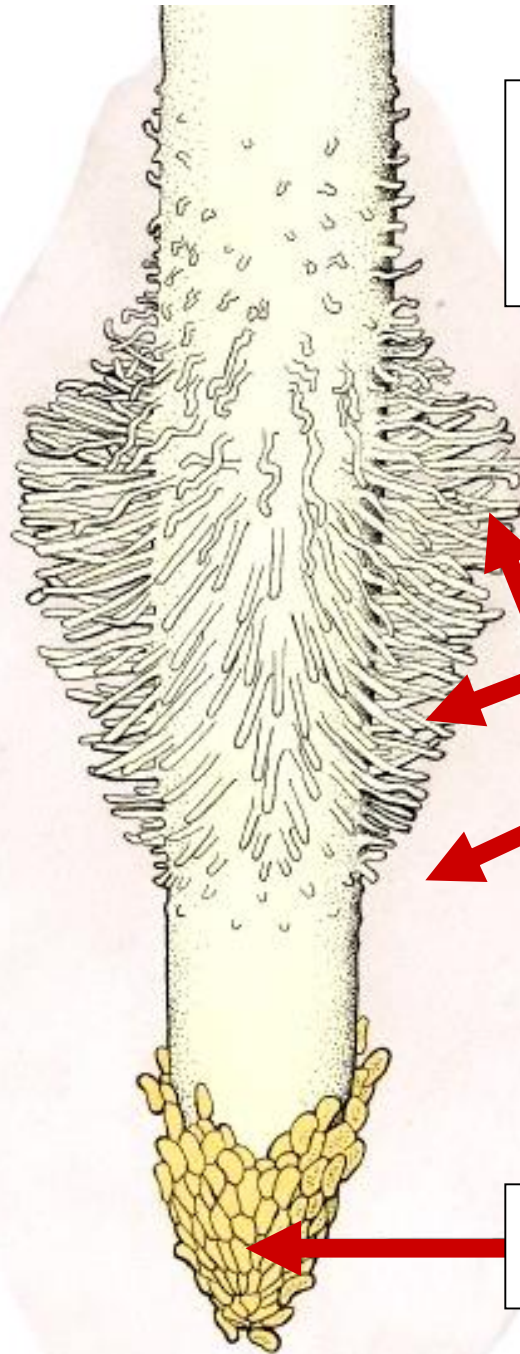
**DIVISION
REGION**

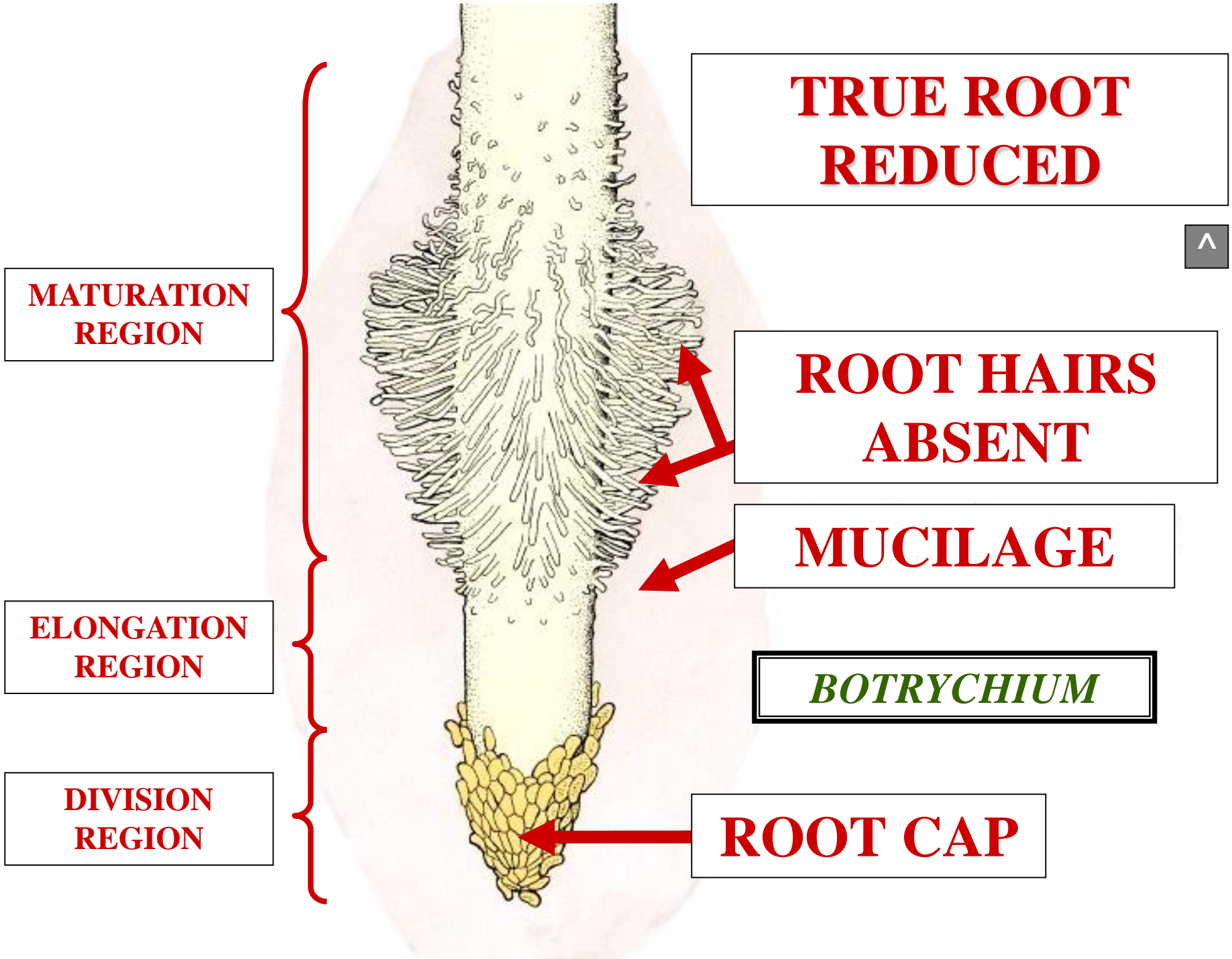
ROOT HAIRS

MUCILAGE

BOTRYCHIUM

ROOT CAP







STEM



STEM STELE

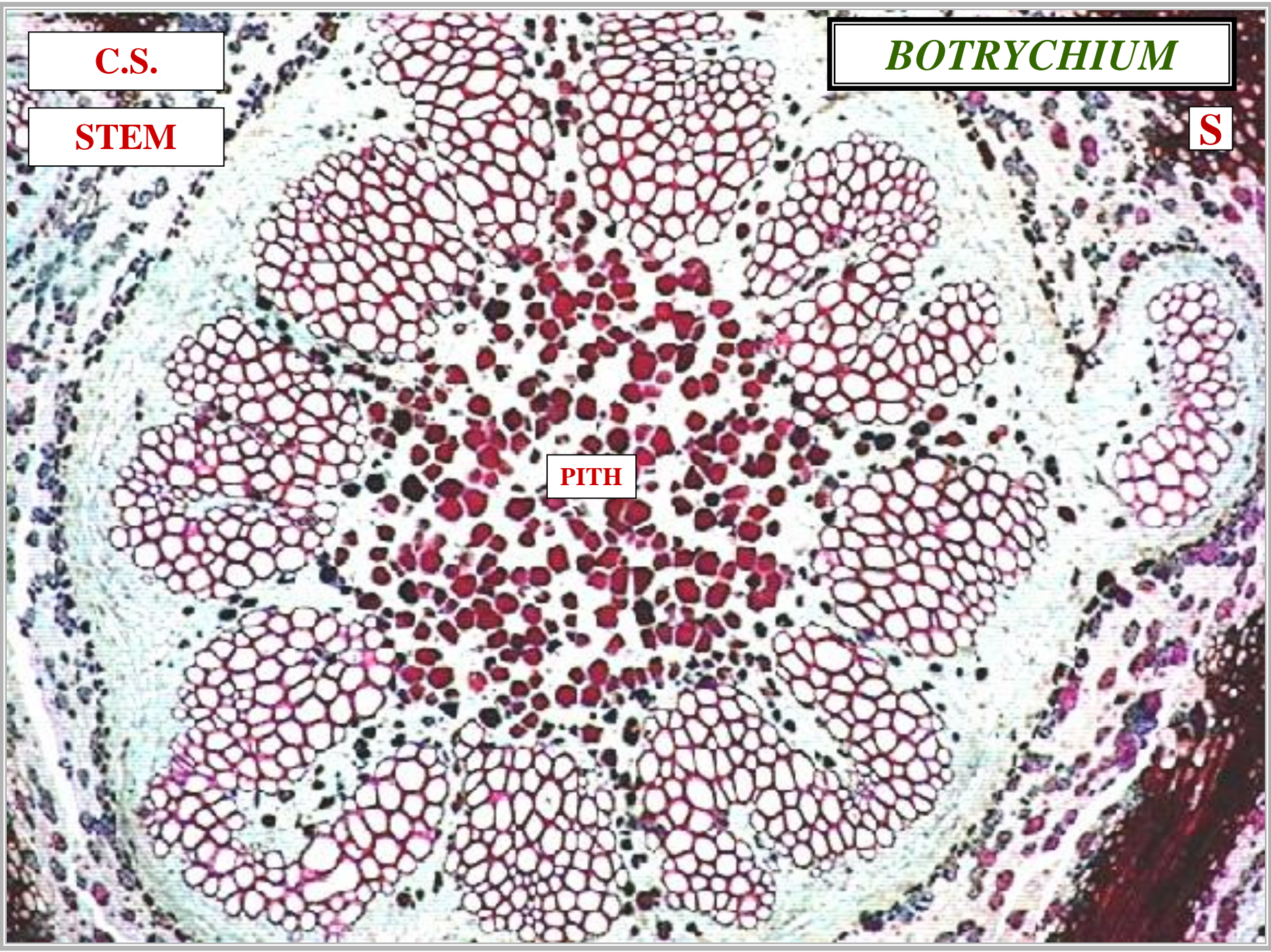
C.S.

BOTRYCHIUM

STEM

S

PITH



BOTRYCHIUM

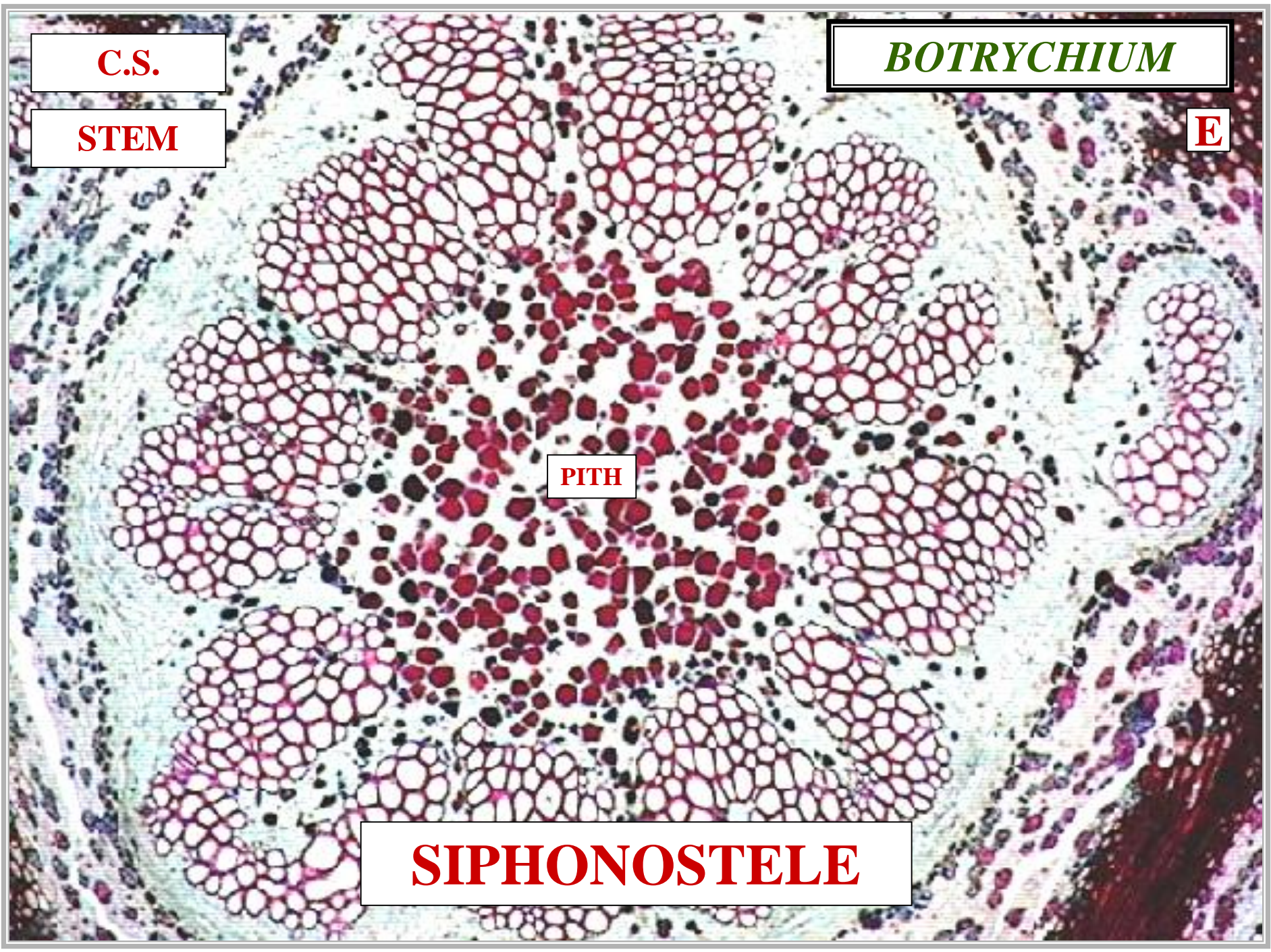
C.S.

STEM

E

PITH

SIPHONOSTELE



C.S.

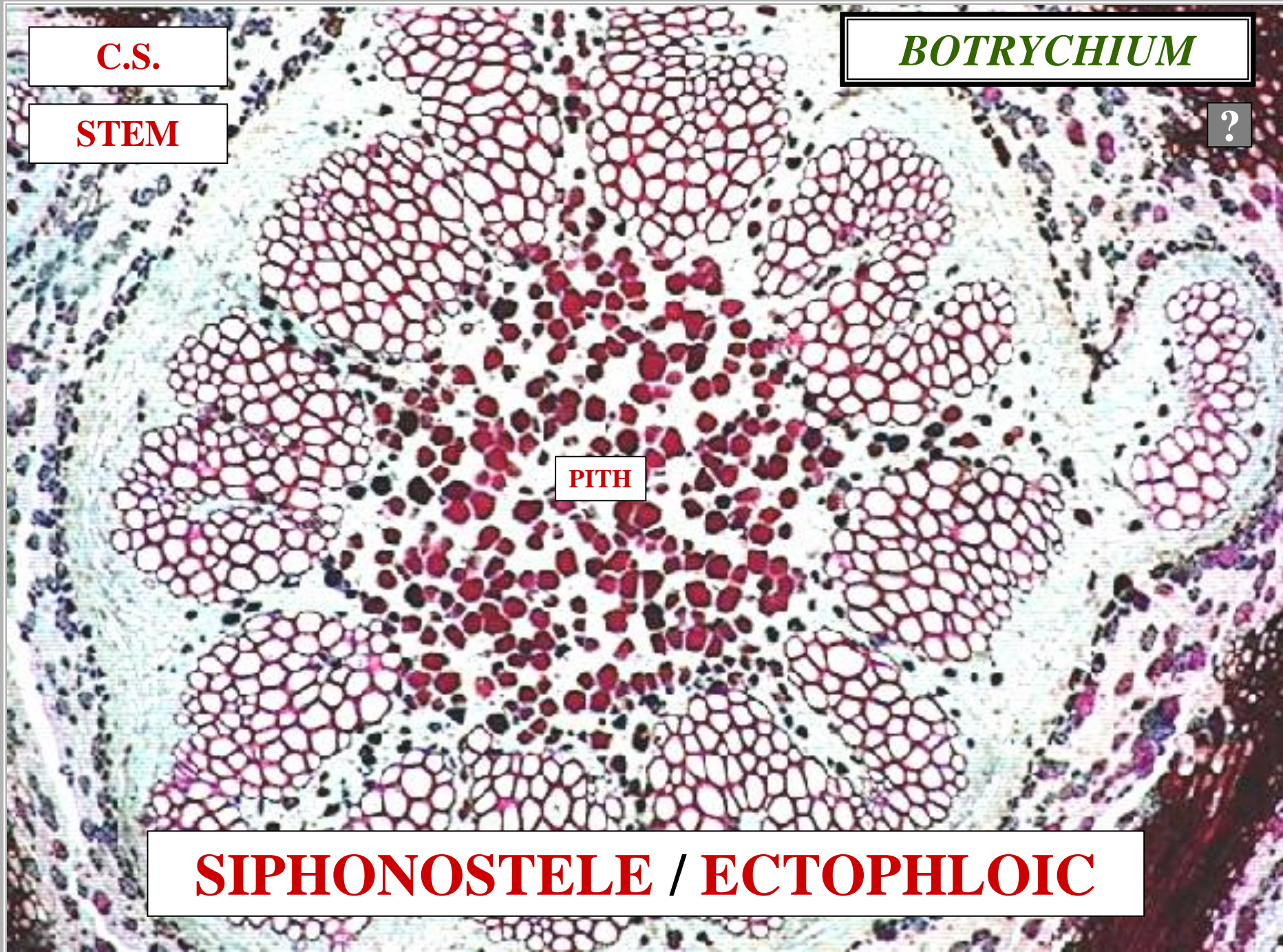
BOTRYCHIUM

STEM

?

PITH

SIPHONOSTELE / ECTOPHLOIC



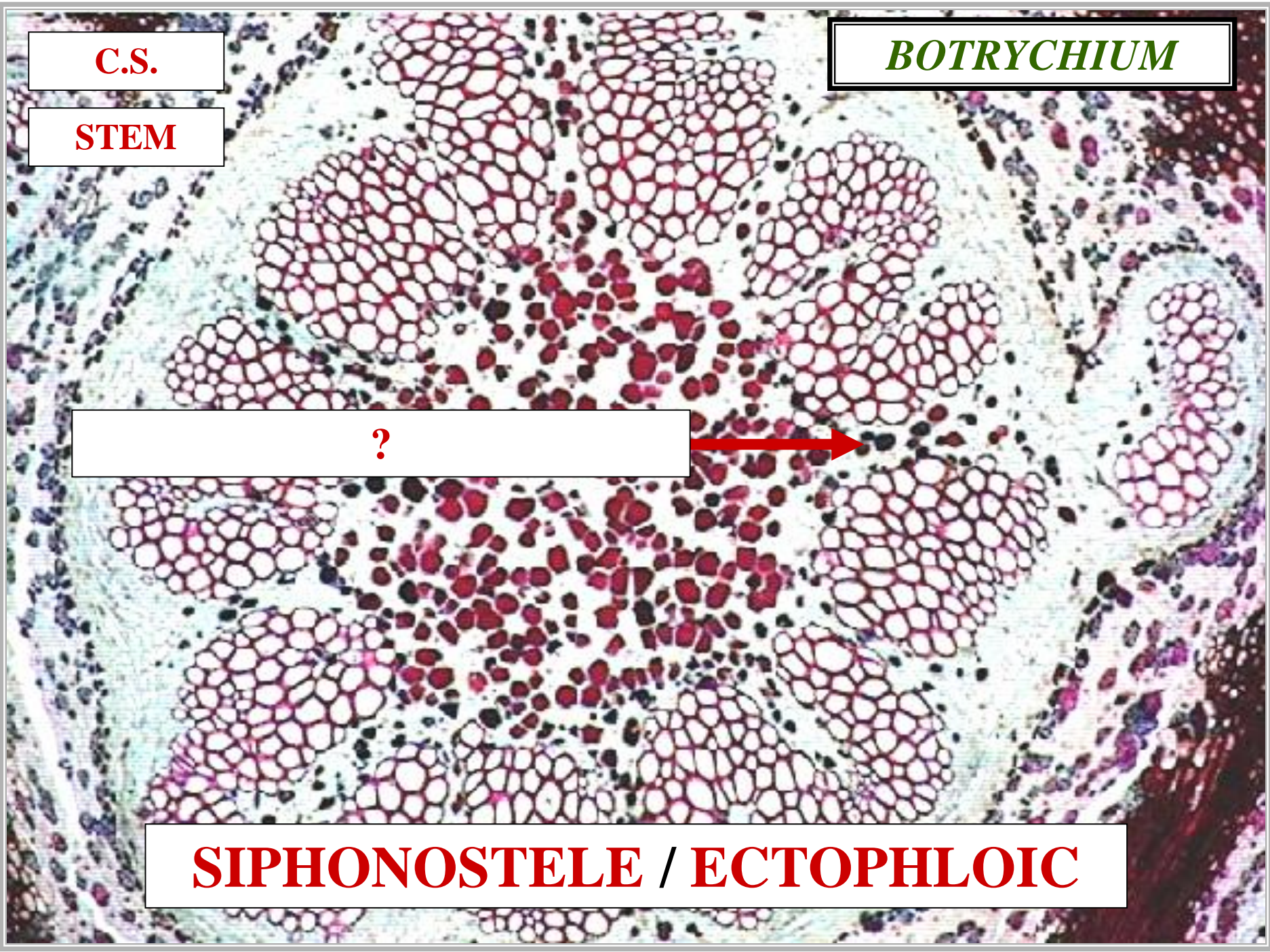
C.S.

BOTRYCHIUM

STEM

?

SIPHONOSTELE / ECTOPHLOIC



C.S.

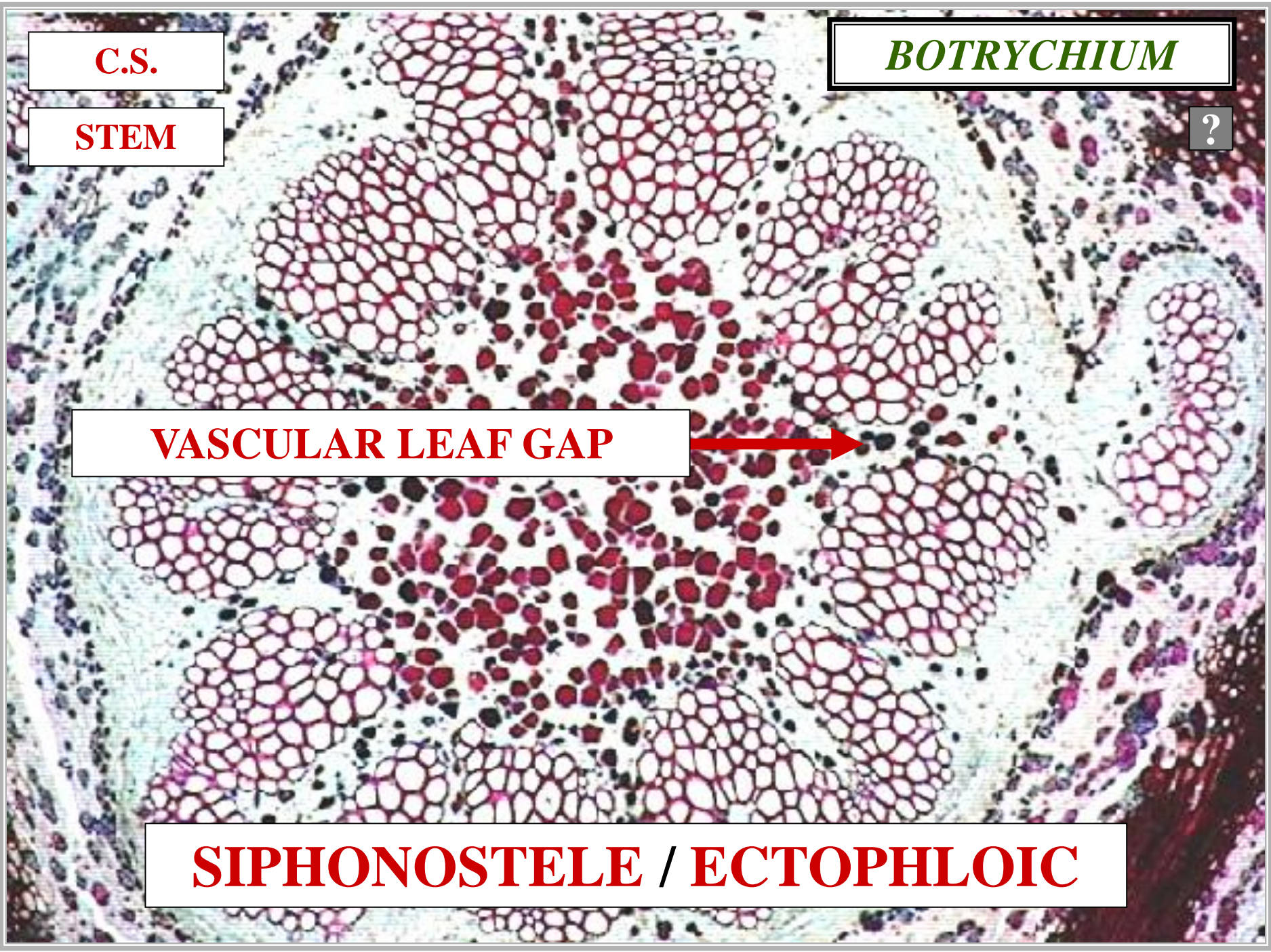
BOTRYCHIUM

STEM

?

VASCULAR LEAF GAP →

SIPHONOSTELE / ECTOPHLOIC



C.S.

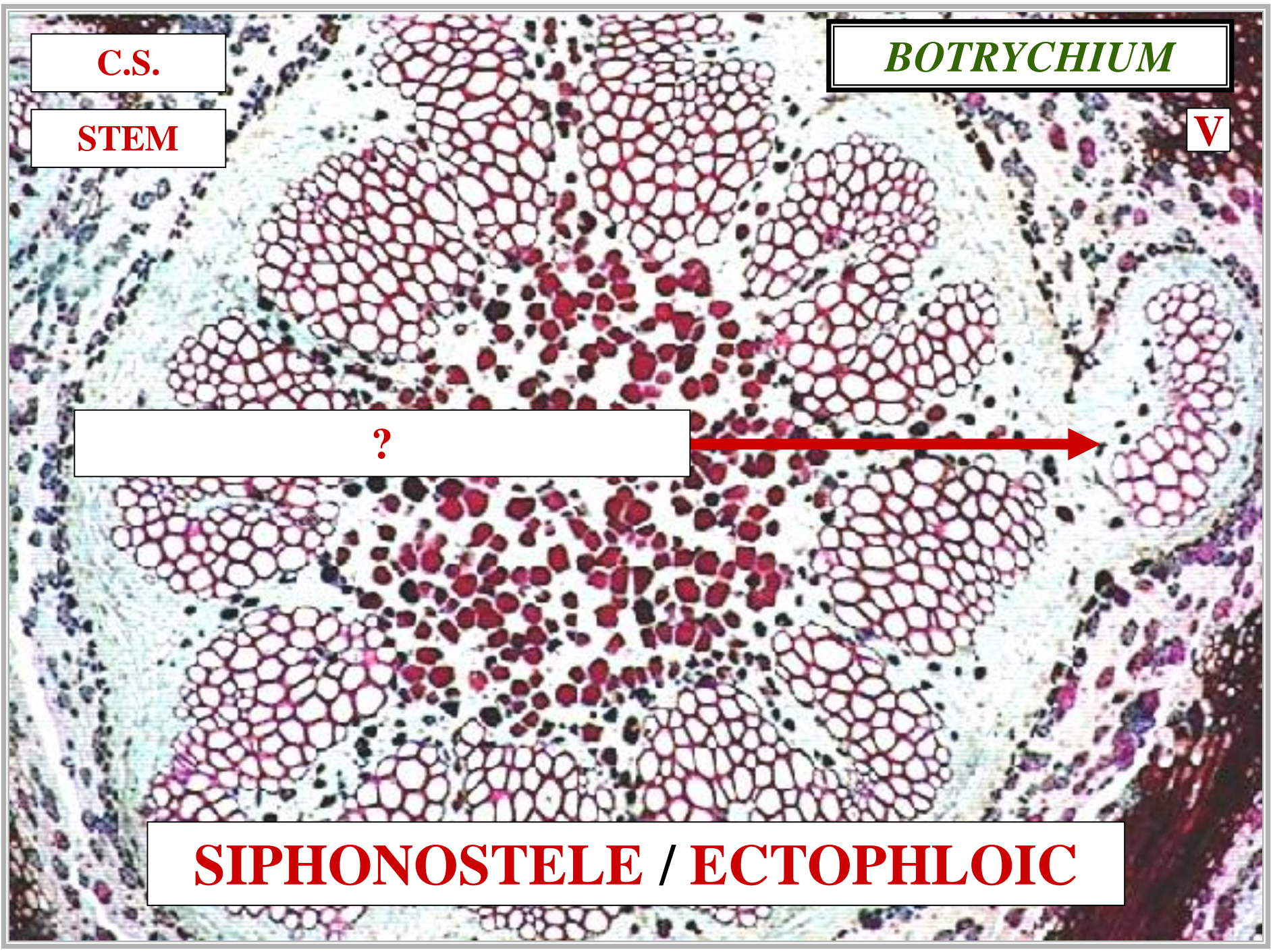
BOTRYCHIUM

STEM

V

?

SIPHONOSTELE / ECTOPHLOIC



C.S.

BOTRYCHIUM

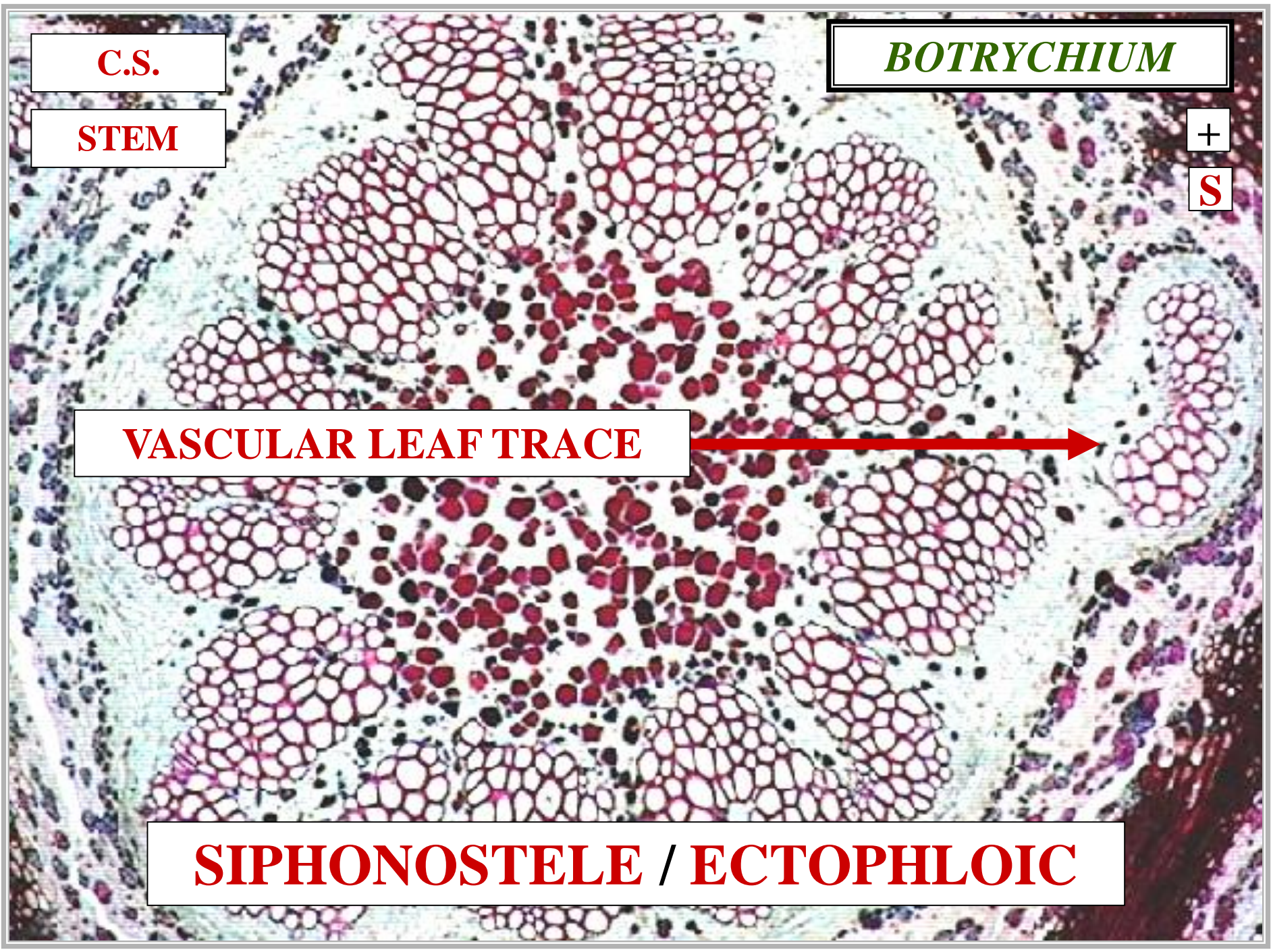
STEM

+

S

VASCULAR LEAF TRACE →

SIPHONOSTELE / ECTOPHLOIC



C.S.

BOTRYCHIUM

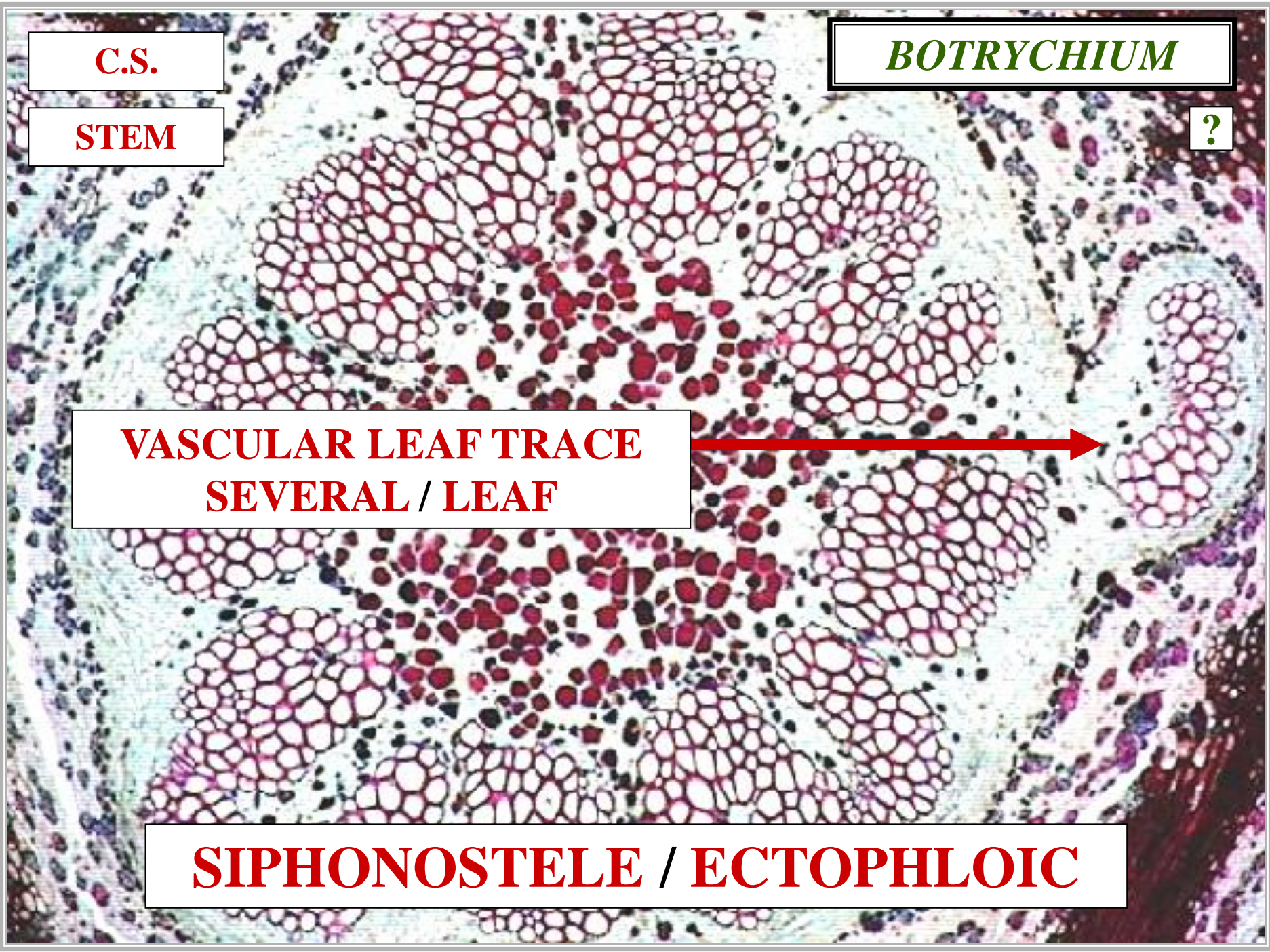
STEM

?

**VASCULAR LEAF TRACE
SEVERAL / LEAF**



SIPHONOSTELE / ECTOPHLOIC



C.S.

BOTRYCHIUM

STEM

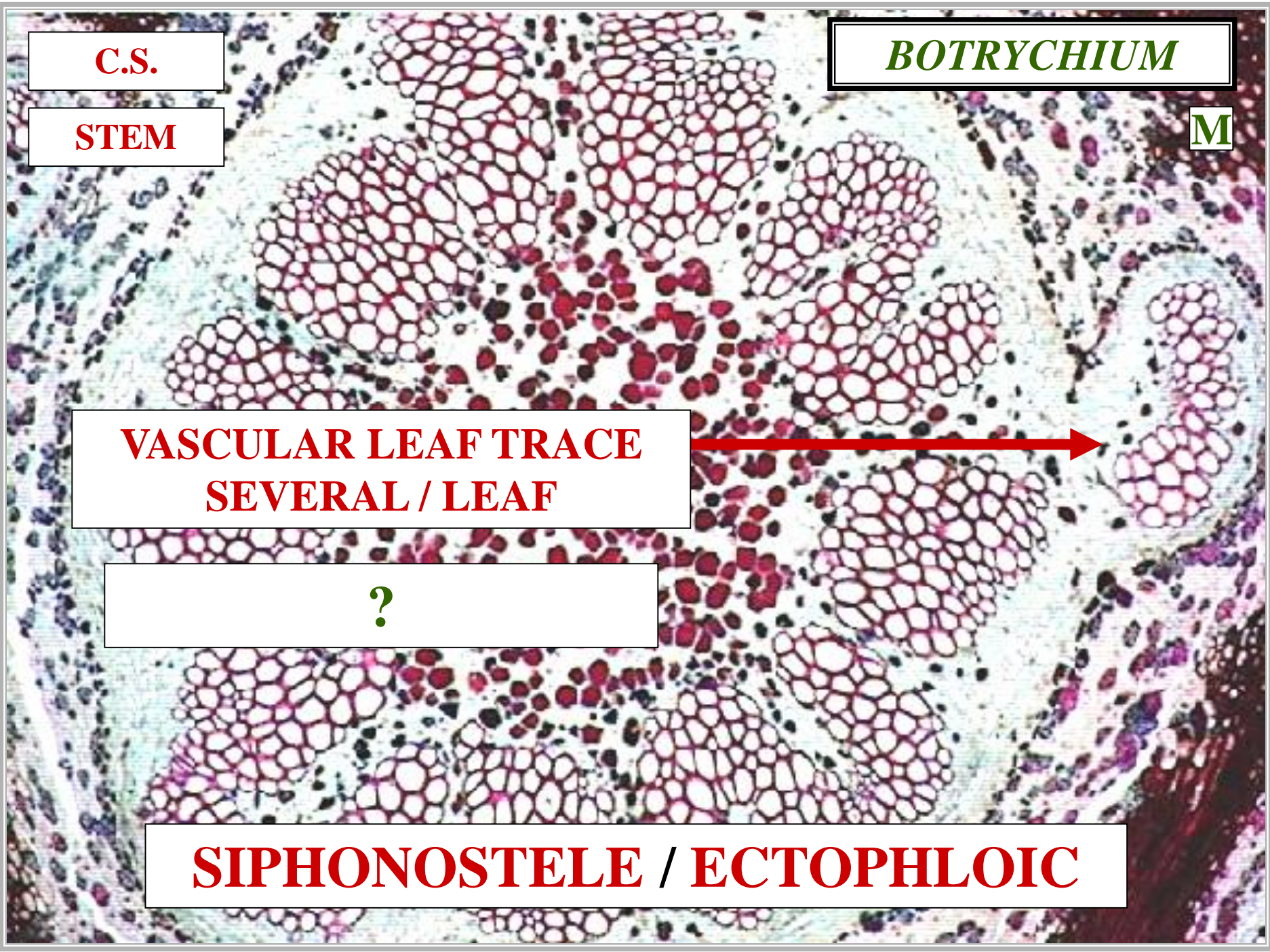
M

**VASCULAR LEAF TRACE
SEVERAL / LEAF**



?

SIPHONOSTELE / ECTOPHLOIC



C.S.

BOTRYCHIUM

STEM

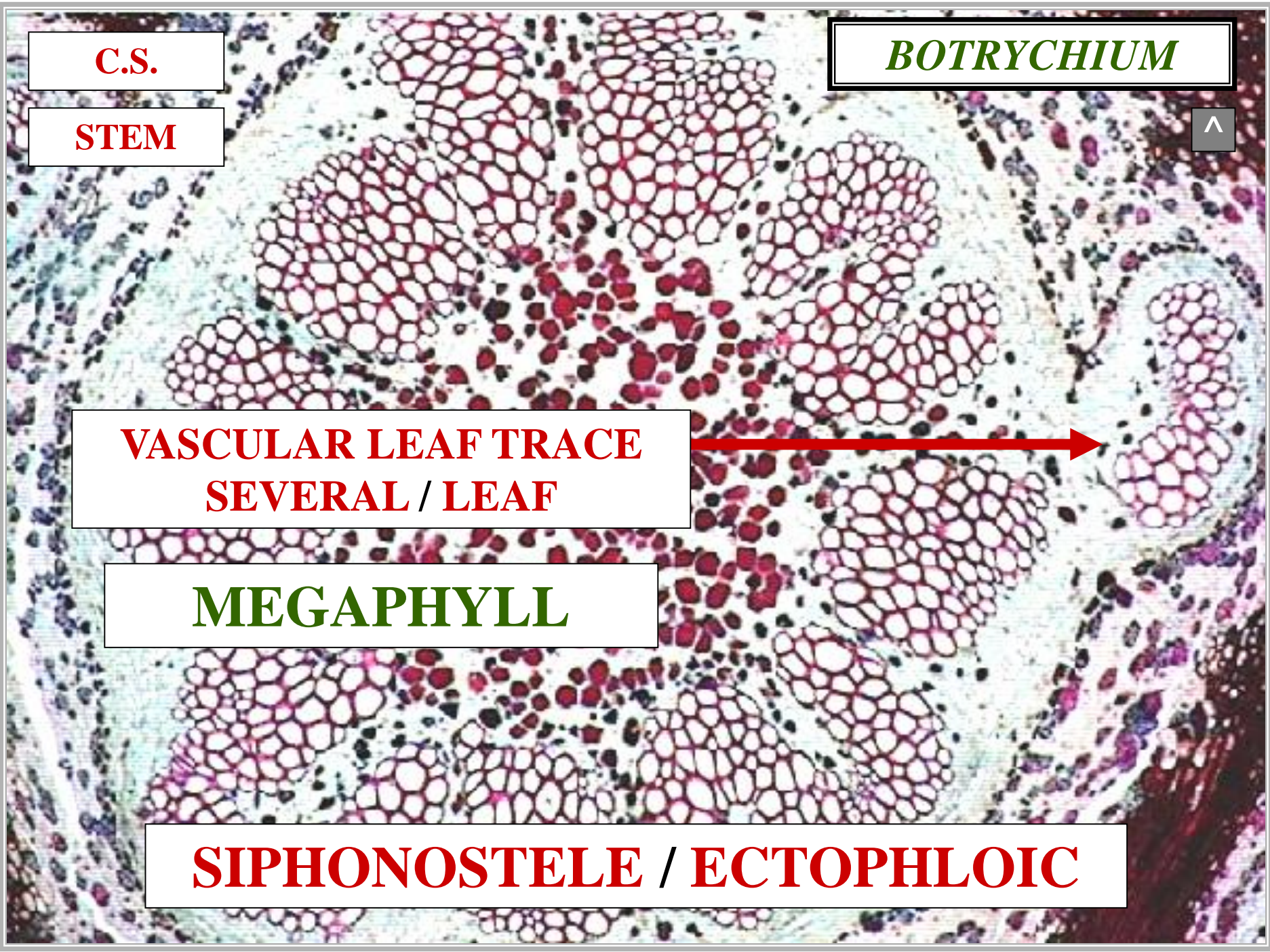


**VASCULAR LEAF TRACE
SEVERAL / LEAF**



MEGAPHYLL

SIPHONOSTELE / ECTOPHLOIC





RHIZOME



ROOTS



RHIZOME



BOTRYCHIUM



ROOTS

VERTICAL GROWTH

BOTRYCHIUM



ROOTS



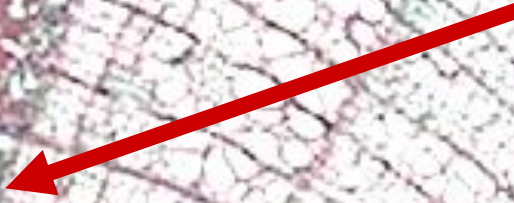
BRANCHING ABSENT



BOTRYCHIUM

VC

?

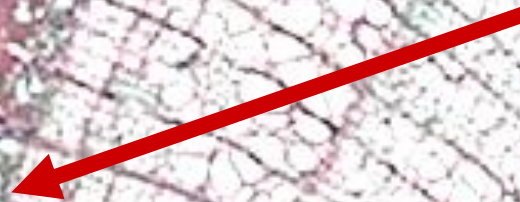


RHIZOME

C.S.

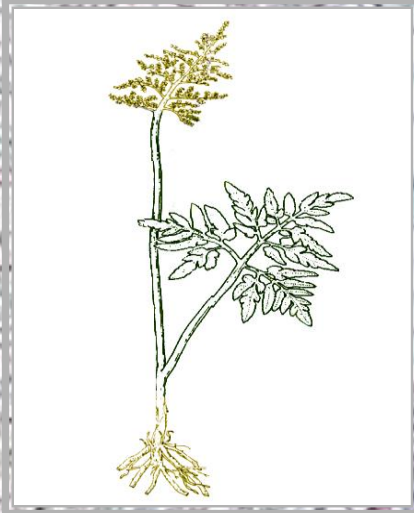
BOTRYCHIUM

**VASCULAR
CAMBIUM**



RHIZOME

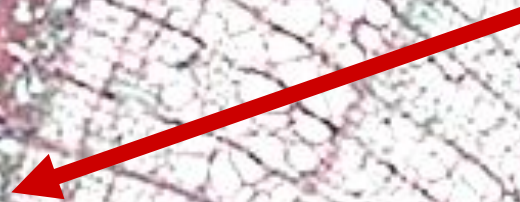
C.S.



BOTRYCHIUM

2
X

VASCULAR
CAMBIUM



~2 PHLOEM

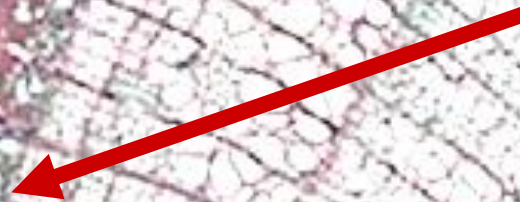
RHIZOME

C.S.



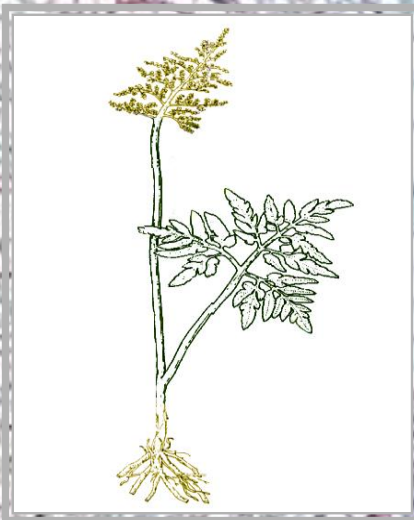
BOTRYCHIUM

**VASCULAR
CAMBIUM**



~2 PHLOEM

~2 XYLEM



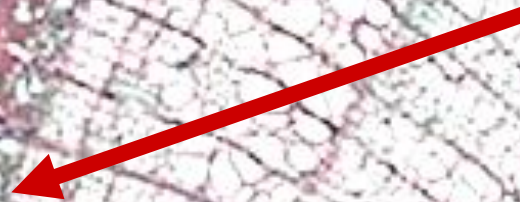
RHIZOME

C.S.

BOTRYCHIUM



**VASCULAR
CAMBIUM**



~2 PHLOEM

~2 XYLEM



SECONDARY GROWTH: PRESENT

RHIZOME

C.S.

BOTRYCHIUM



BOTRYCHIUM

ONLY KNOWN

FERN WITH

SECONDARY GROWTH

FROND



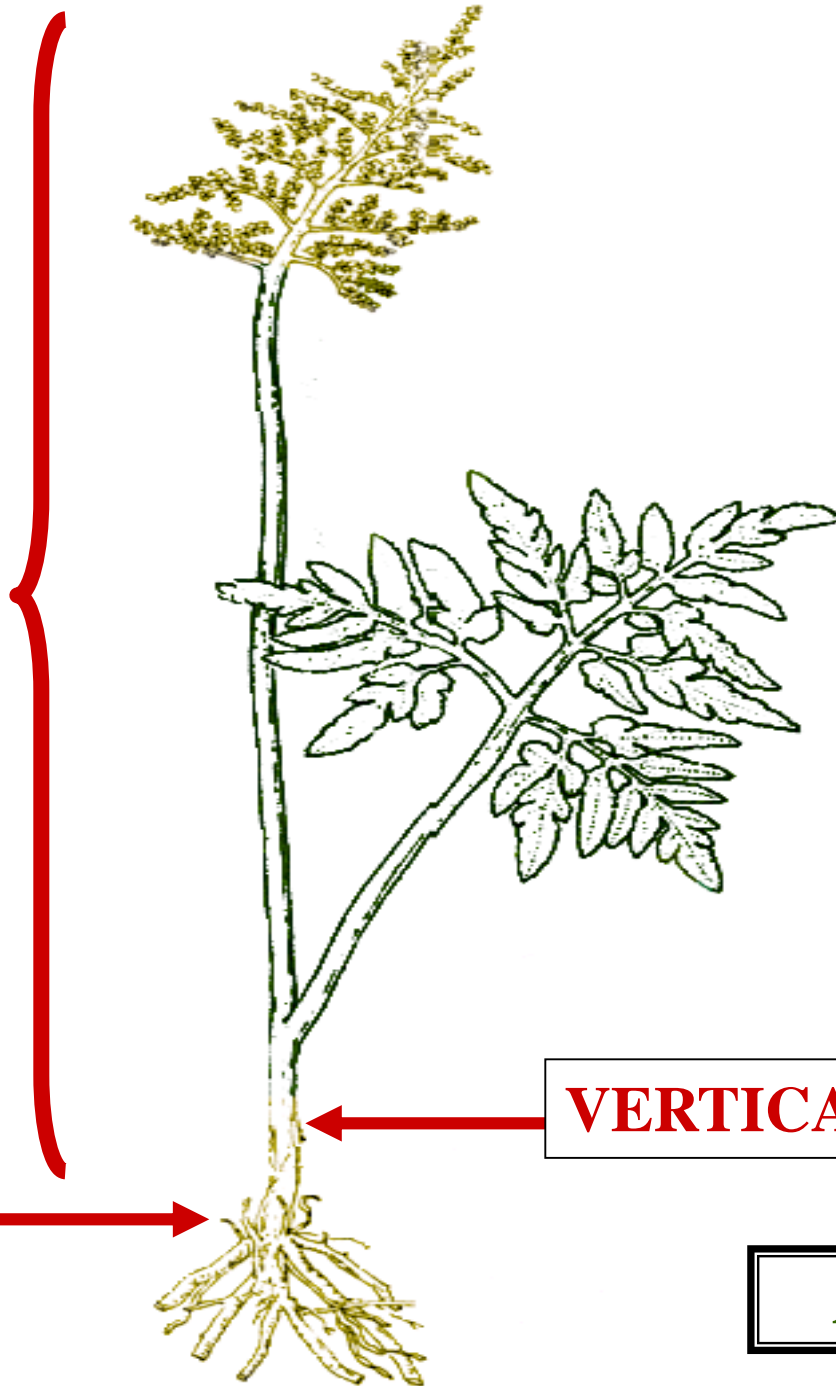
BOTYRICHIUM



OPHIOGLOSSUM



**1 FROND
PER
SEASON**



ROOTS

VERTICAL RHIZOME

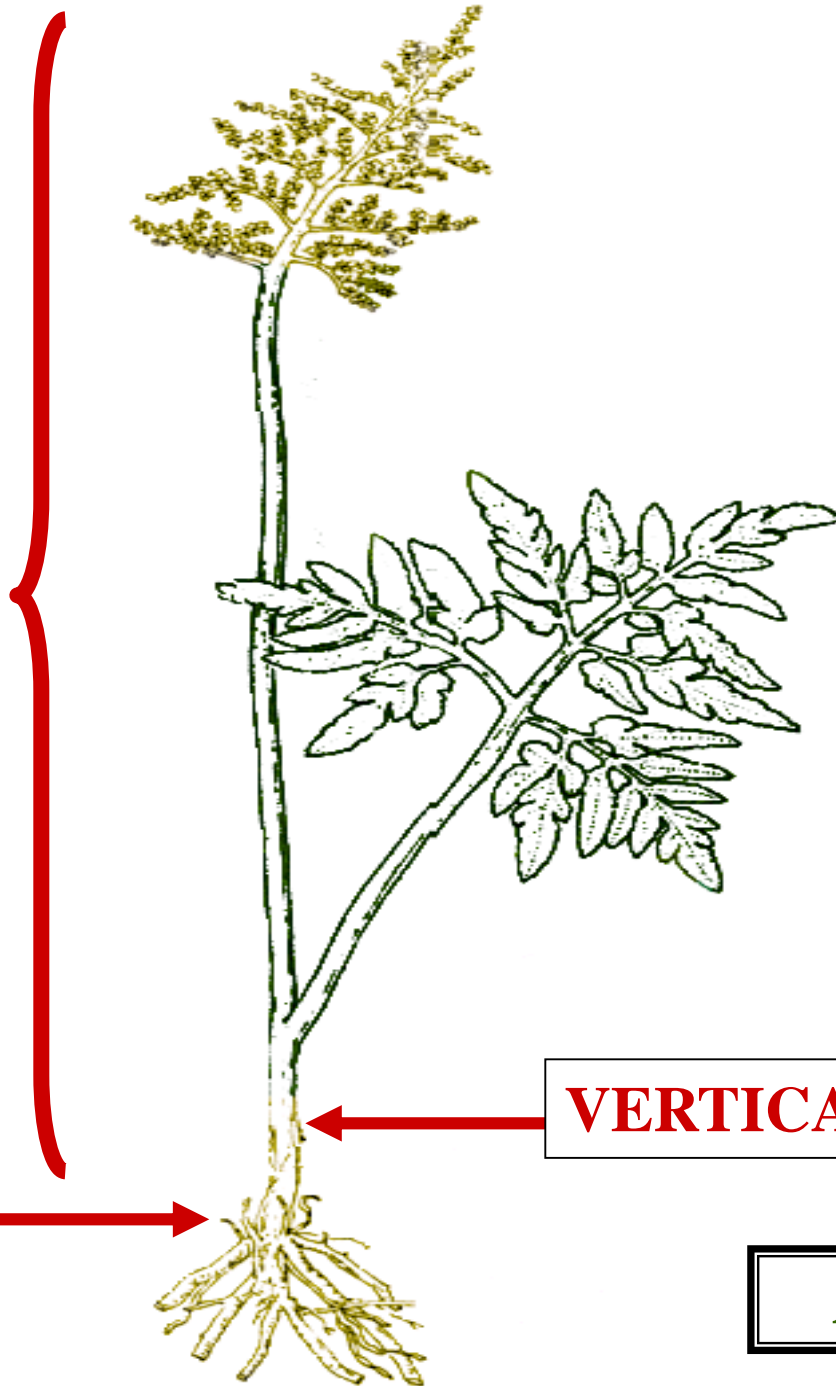
BOTRYCHIUM



PHYLLOTAXY



**1 FROND
PER
SEASON**



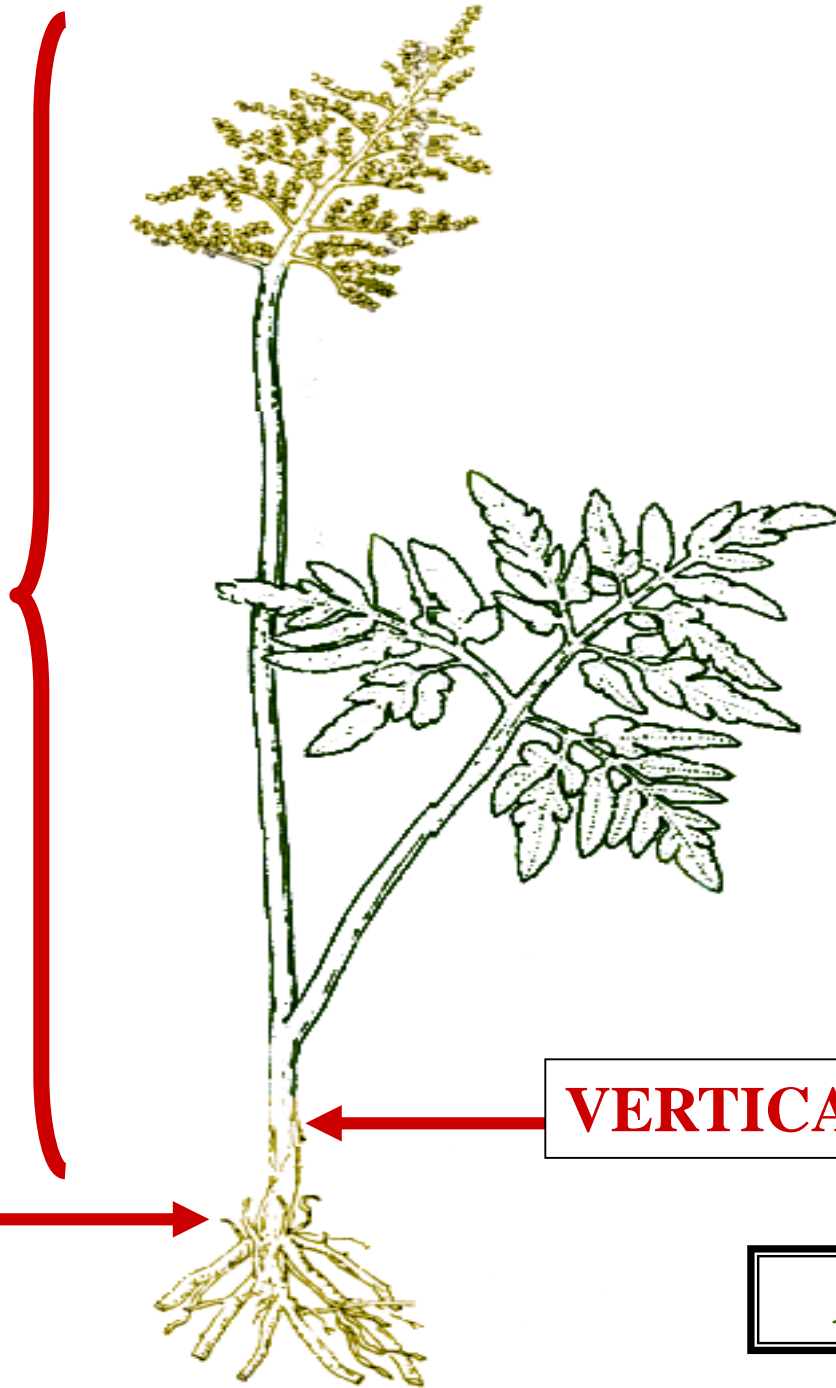
VERTICAL RHIZOME

ROOTS

BOTRYCHIUM



**1 FROND
PER
NODE**



VERTICAL RHIZOME

ROOTS

BOTRYCHIUM



**1 FROND
PER
NODE**



ALTERNATE PHYLLOTAXY

ROOTS

BOTRYCHIUM



FROND VERNATION



**1 FROND
PER
SEASON**



**FROND
VERNATION**

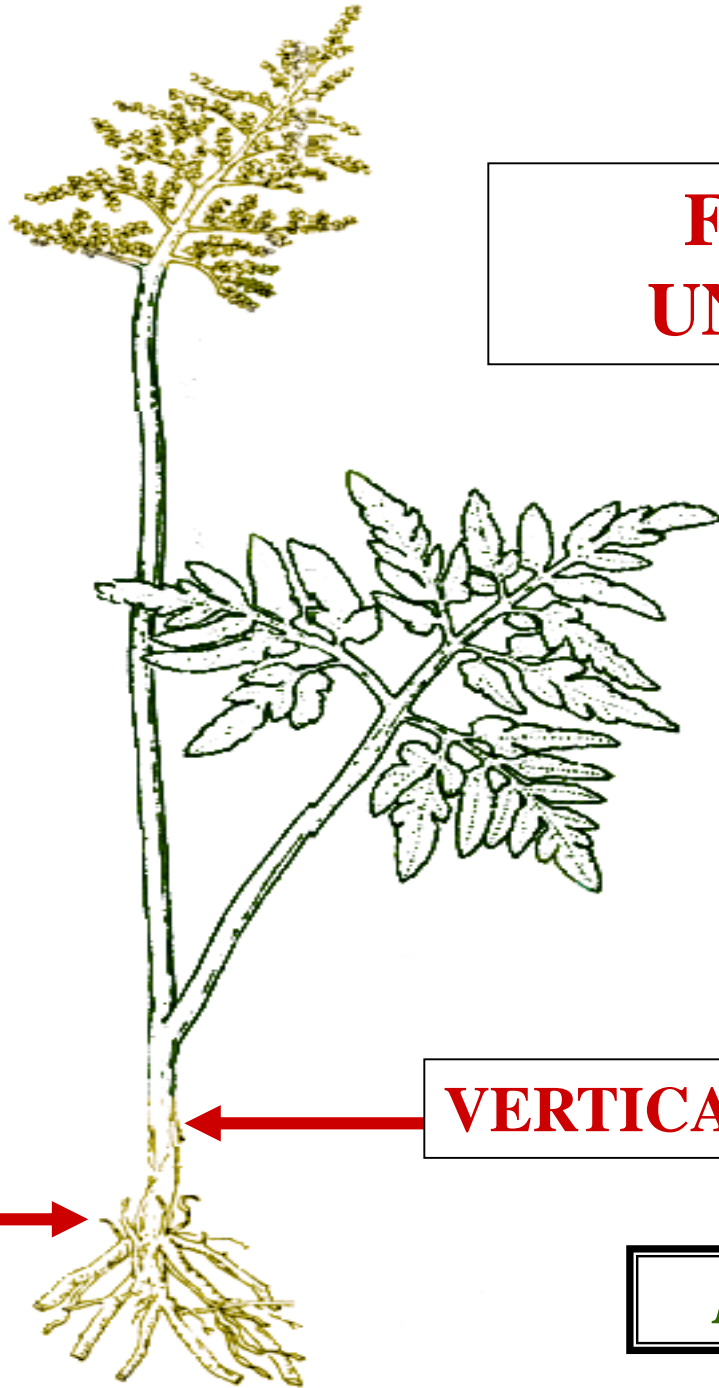
VERTICAL RHIZOME

ROOTS

BOTRYCHIUM



**1 FROND
PER
SEASON**



**FROND
UNFOLDS**

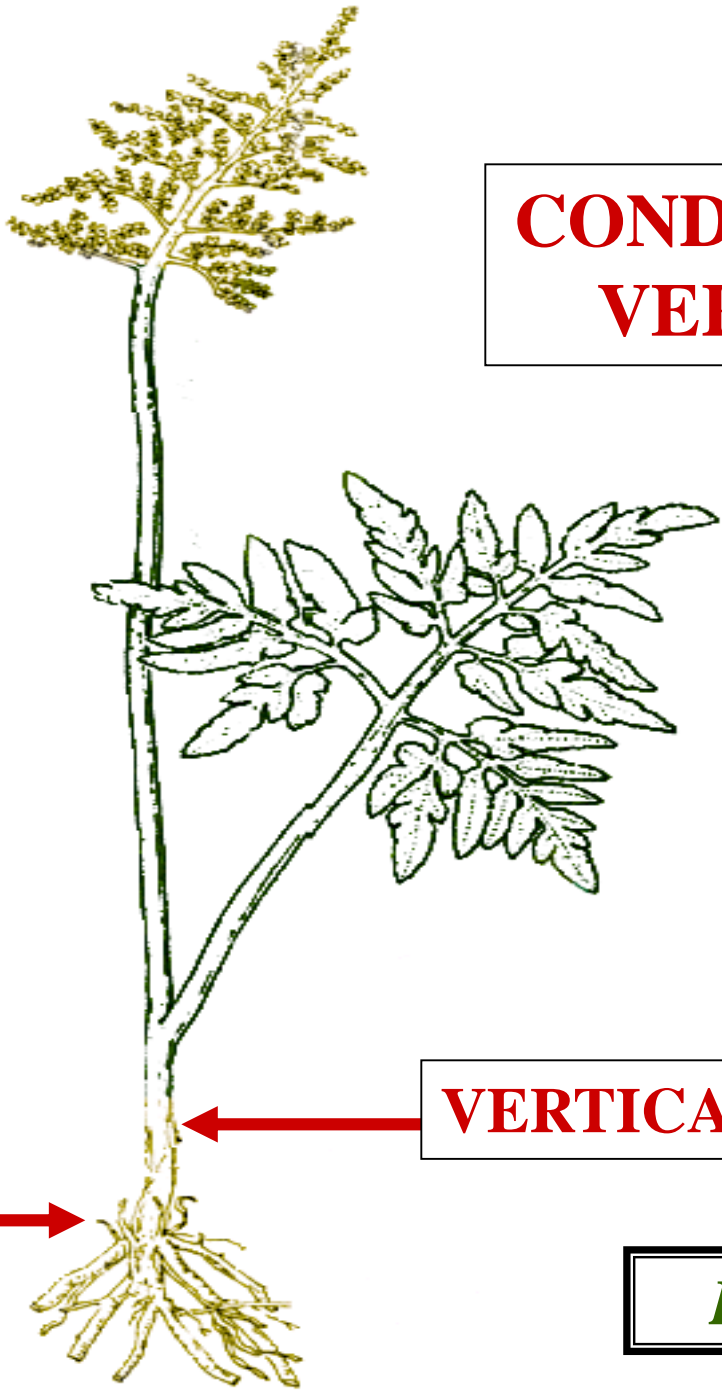
VERTICAL RHIZOME

ROOTS

BOTRYCHIUM



**1 FROND
PER
SEASON**



**CONDUPLICATE
VERNATION**

VERTICAL RHIZOME

ROOTS

BOTRYCHIUM

FROND MORPHOLOGY



**PINNAE
PRESENT**



PINNA

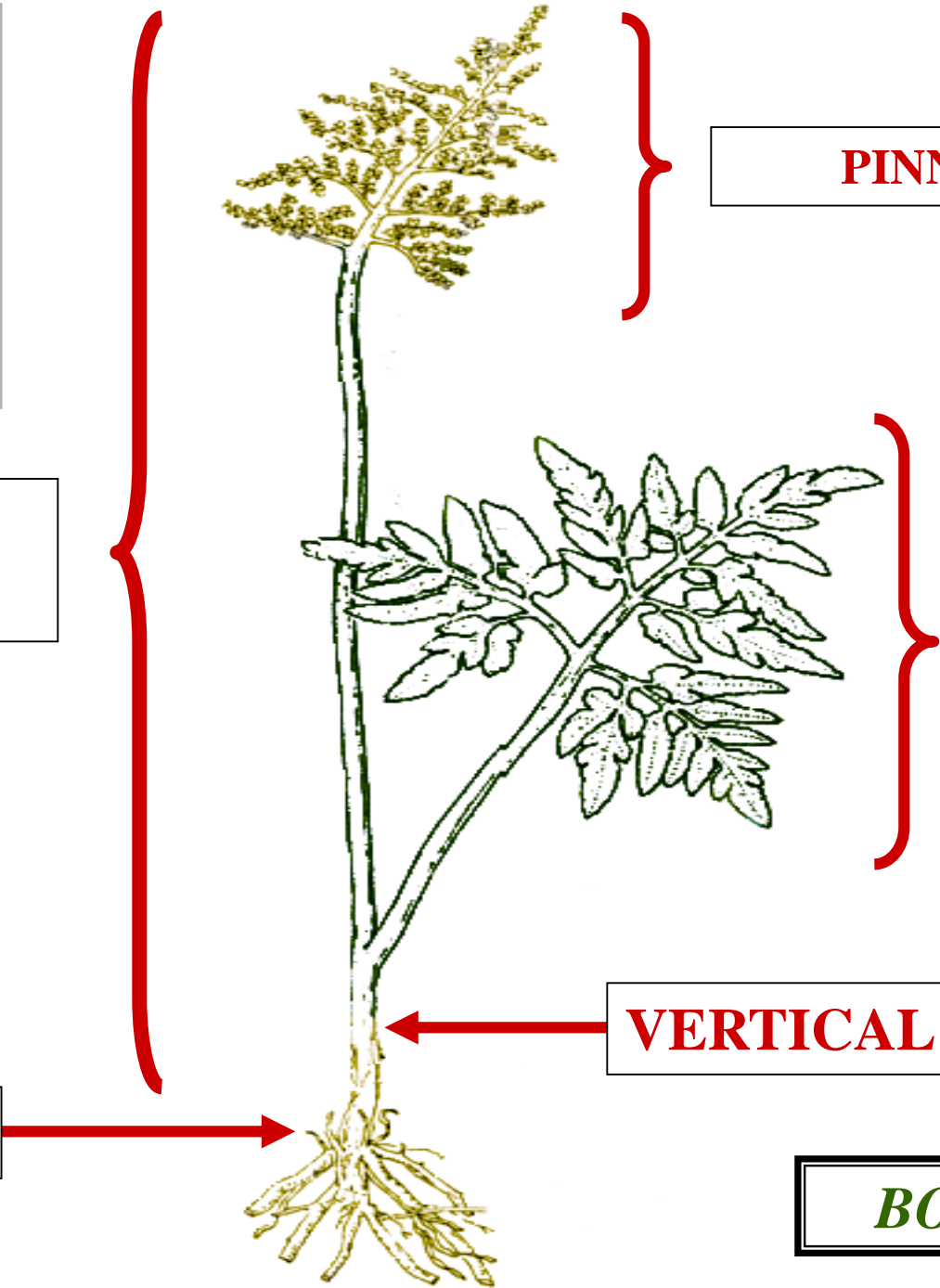


PINNA

VERTICAL RHIZOME

ROOTS

BOTRYCHIUM





**COMPOUND
FROND**



PINNA

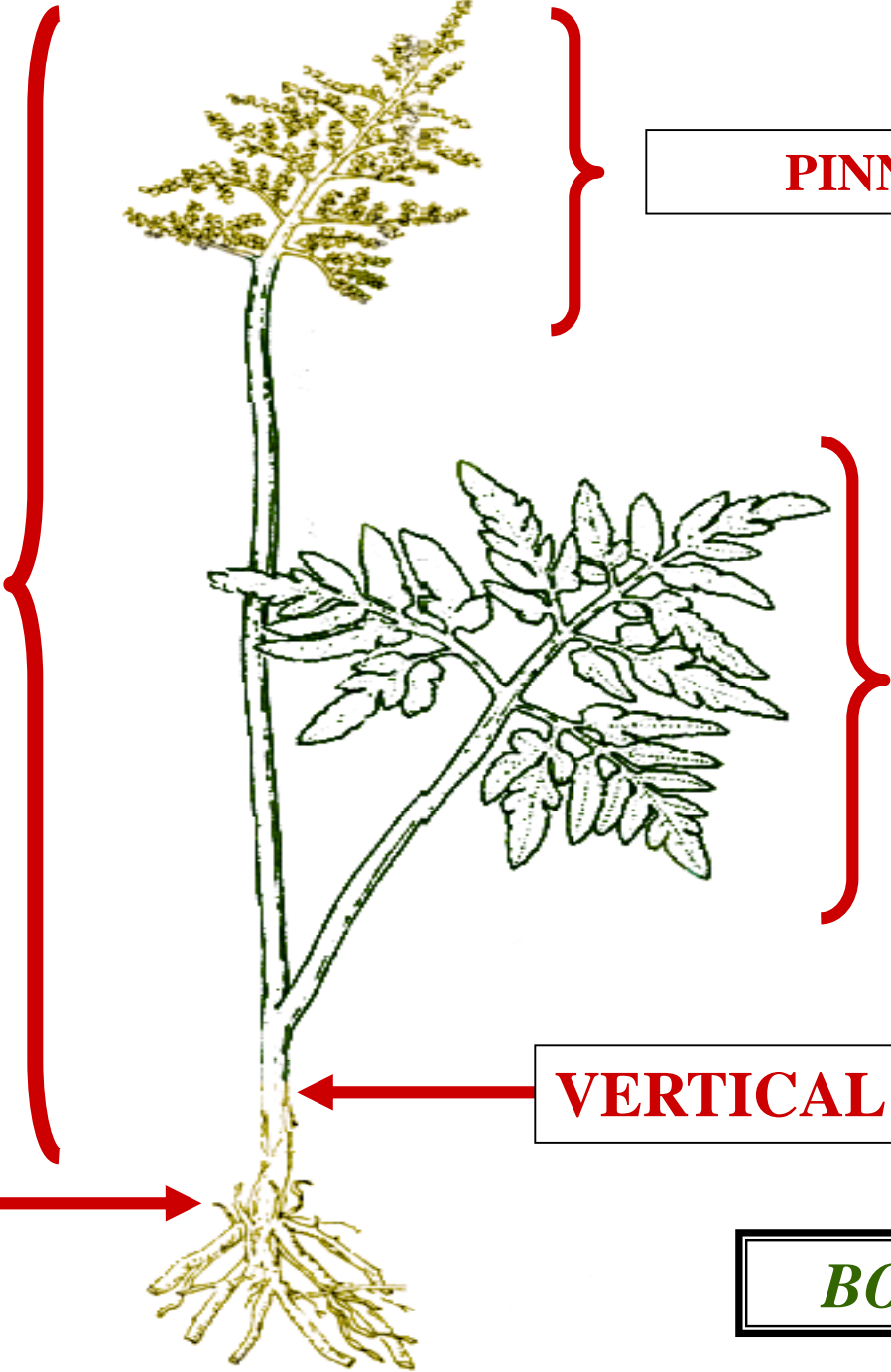


PINNA

VERTICAL RHIZOME

ROOTS

BOTRYCHIUM





**COMPOUND
FROND**



**NON-FERTILE
PINNA**

VERTICAL RHIZOME

ROOTS

BOTRYCHIUM



**COMPOUND
FROND**



PSYN

VERTICAL RHIZOME

ROOTS

BOTRYCHIUM



**COMPOUND
FROND**



**FERTILE
PINNA**

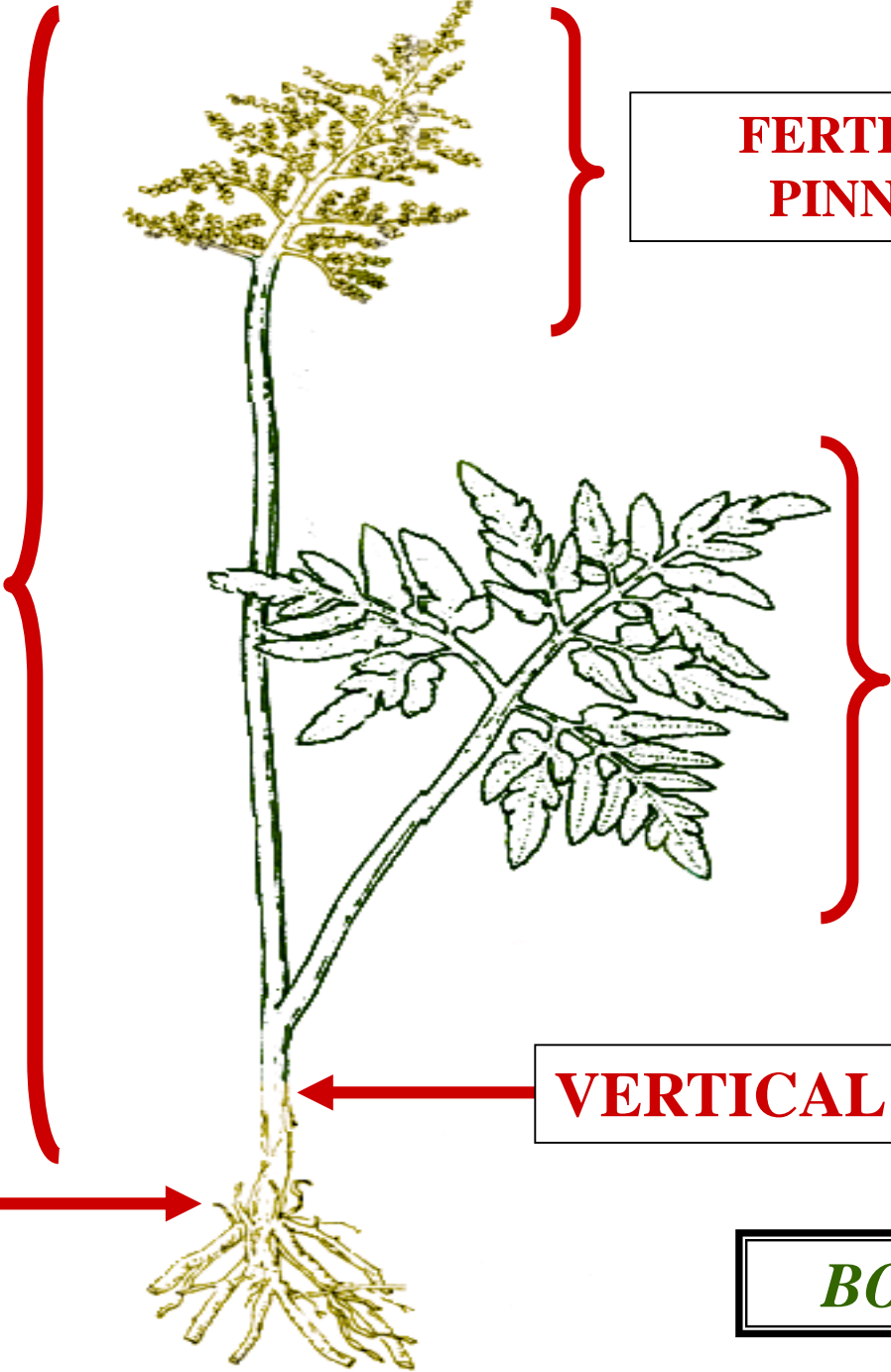


**NON-FERTILE
PINNA**

VERTICAL RHIZOME

ROOTS

BOTRYCHIUM





**COMPOUND
FROND**



NON-PSYN

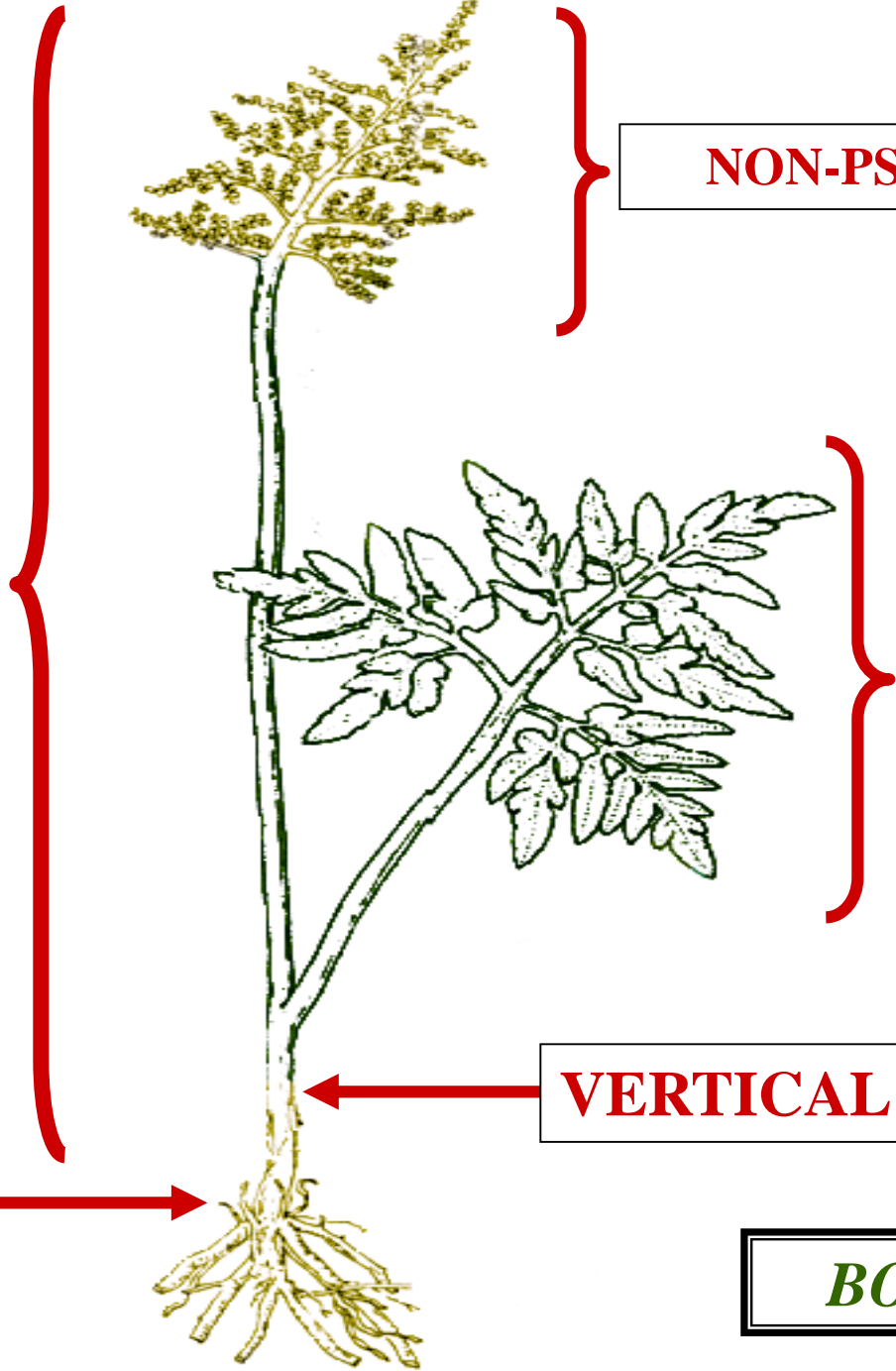


**NON-FERTILE
PINNA**

VERTICAL RHIZOME

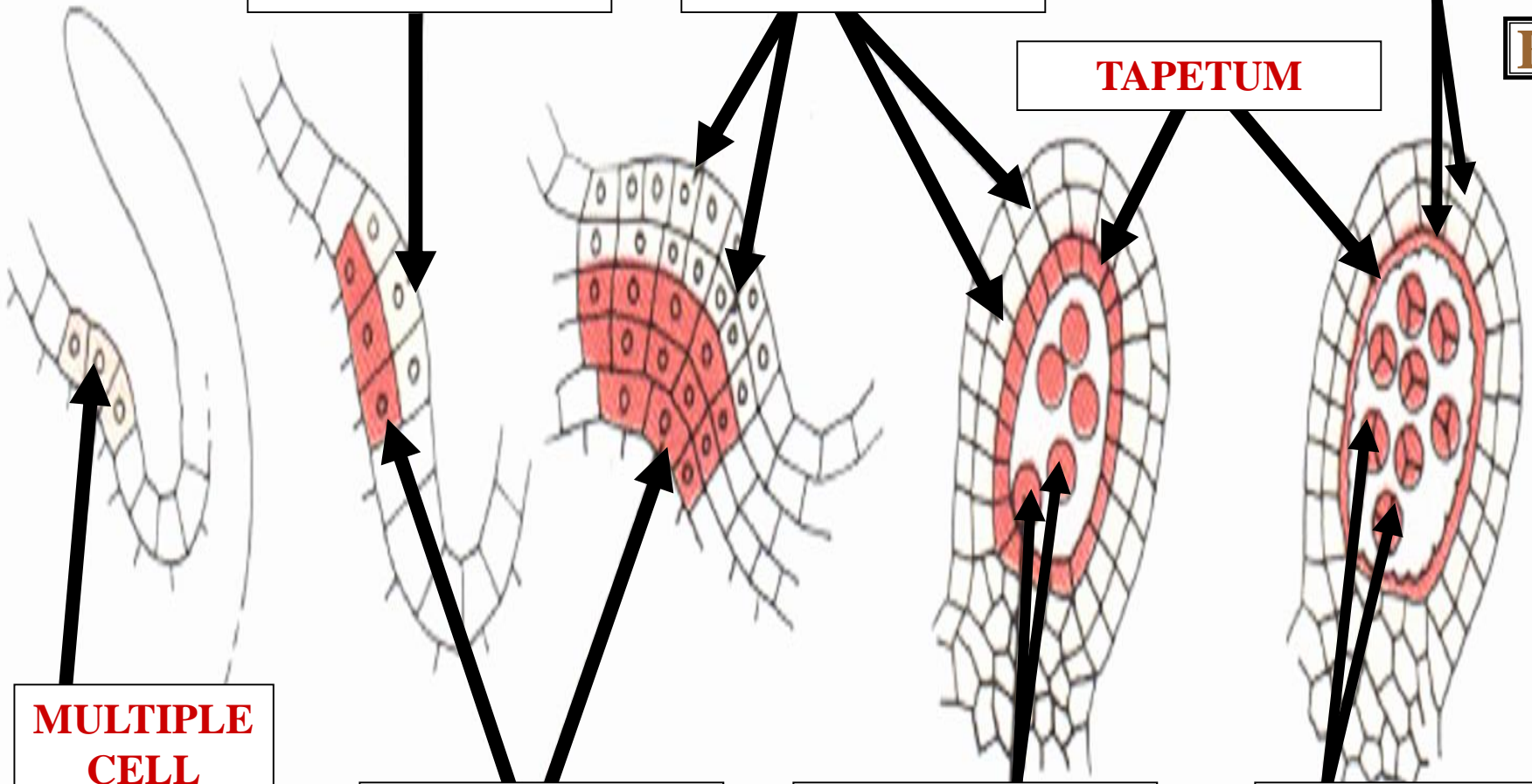
ROOTS

BOTRYCHIUM





SPORANGIUM



WALL CELLS

WALL CELLS

LARGE SIZE

THICK WALL

E

TAPETUM

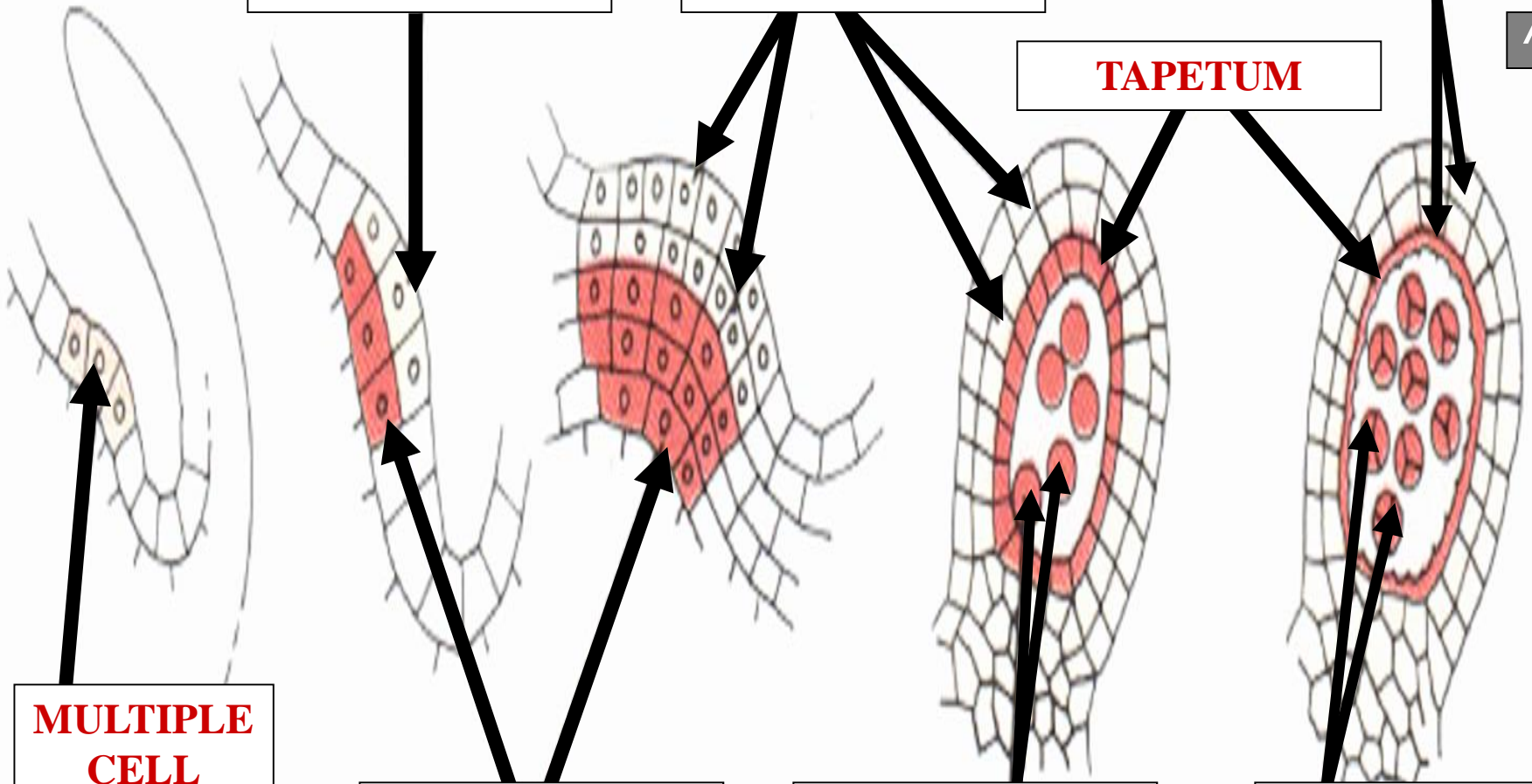
**MULTIPLE
CELL
INITIALS**

SPOROCTYES

SPOROCTYES

**NUMEROUS
SPORES**

L.S.



WALL CELLS

WALL CELLS

LARGE SIZE

THICK WALL

TAPETUM

**MULTIPLE
CELL
INITIALS**

SPOROCYTES

SPOROCYTES

**NUMEROUS
SPORES**

EUSPORANGIUM

L.S.



SPORANGIUM POSITION



**COMPOUND
FROND**



**FERTILE
PINNA**



**NON-FERTILE
PINNA**

VERTICAL RHIZOME

ROOTS

BOTRYCHIUM



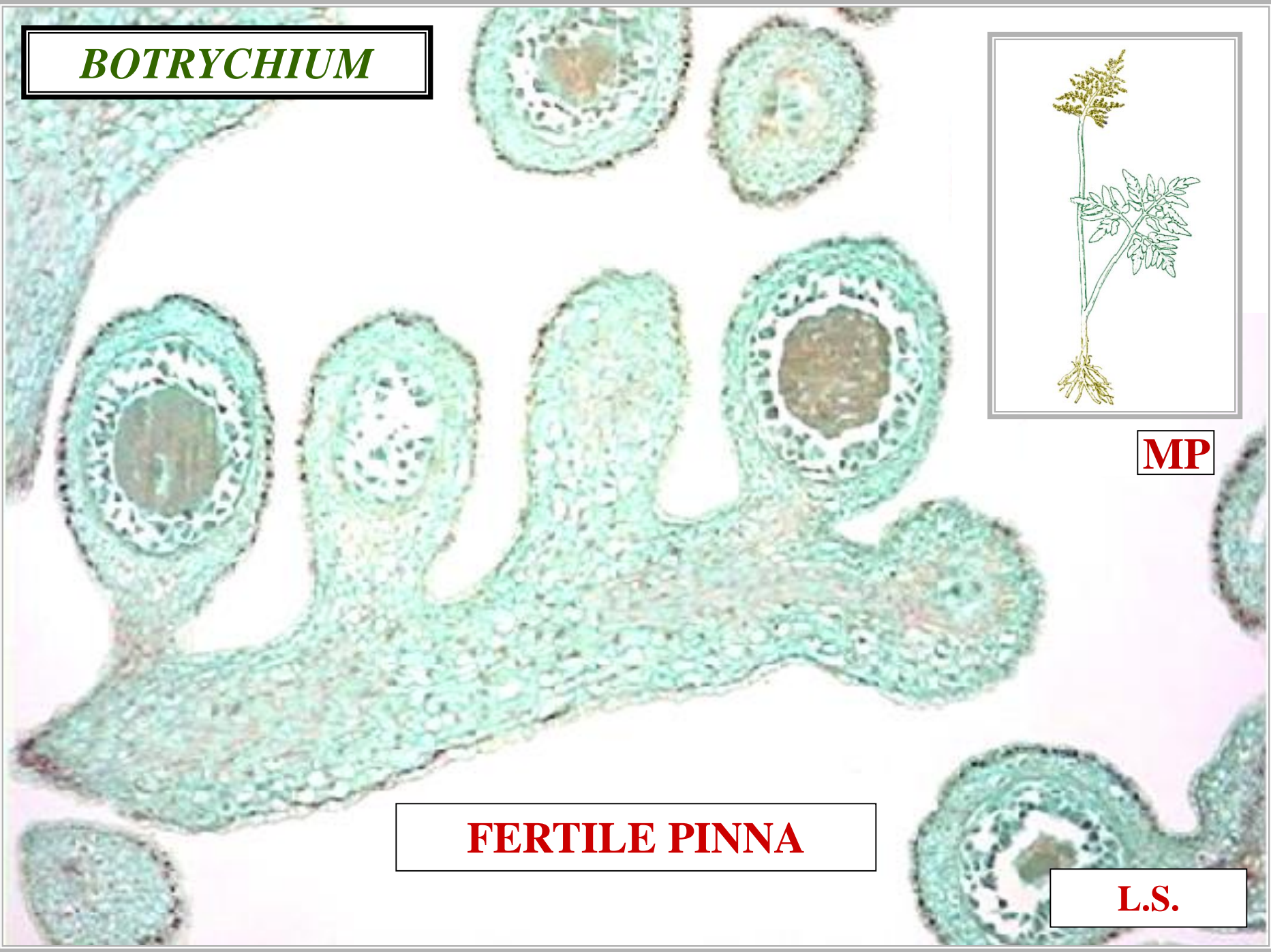
BOTRYCHIUM



MP

FERTILE PINNA

L.S.

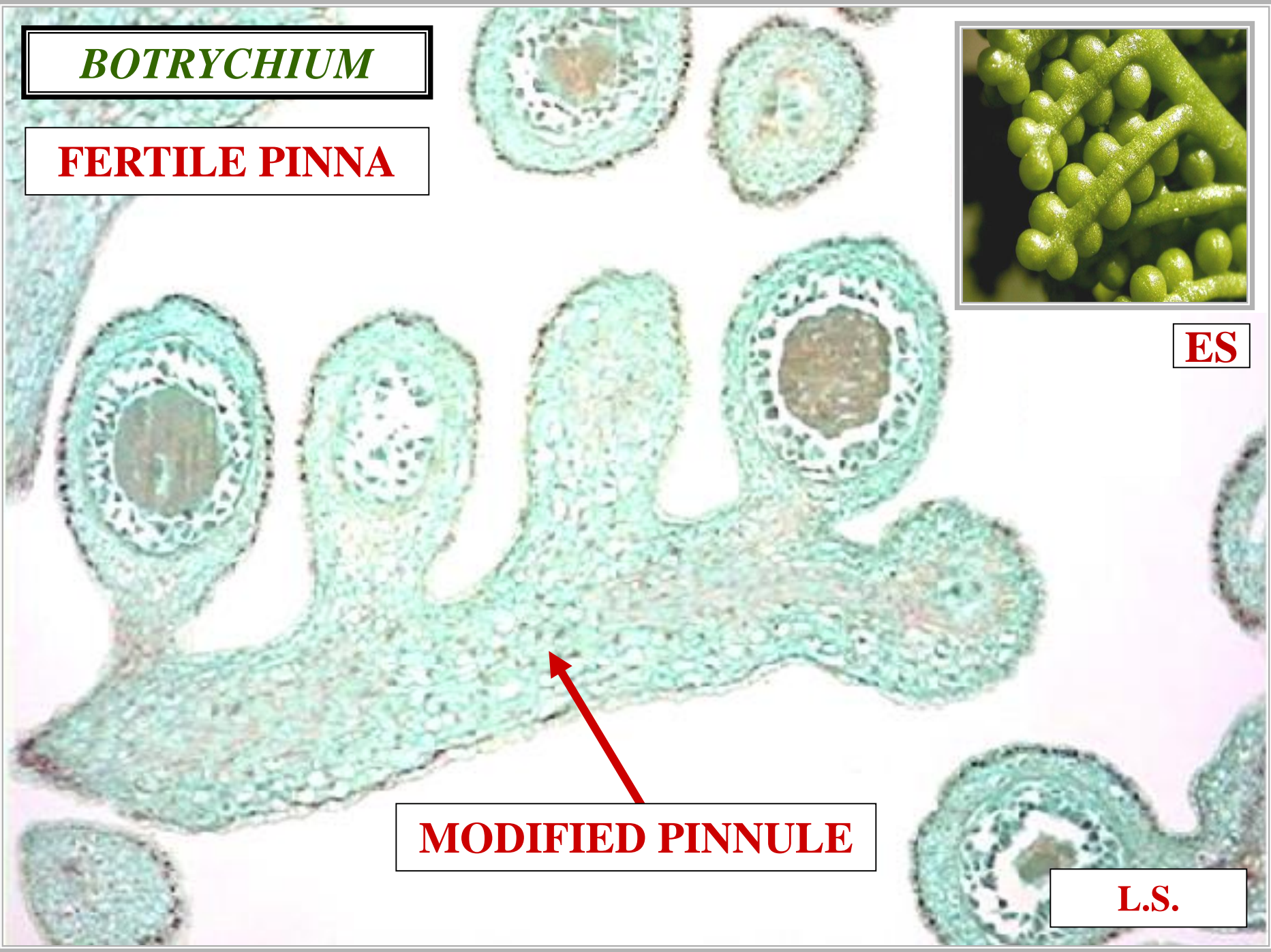


BOTRYCHIUM

FERTILE PINNA



ES



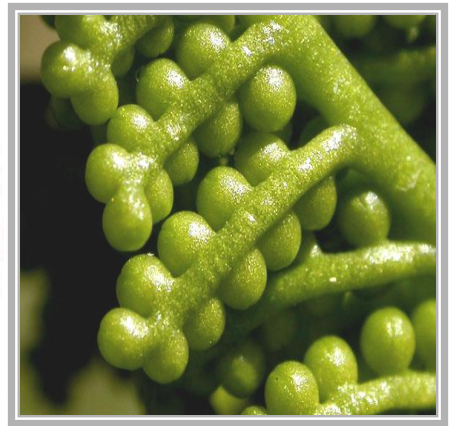
MODIFIED PINNULE

L.S.

BOTRYCHIUM

FERTILE PINNA

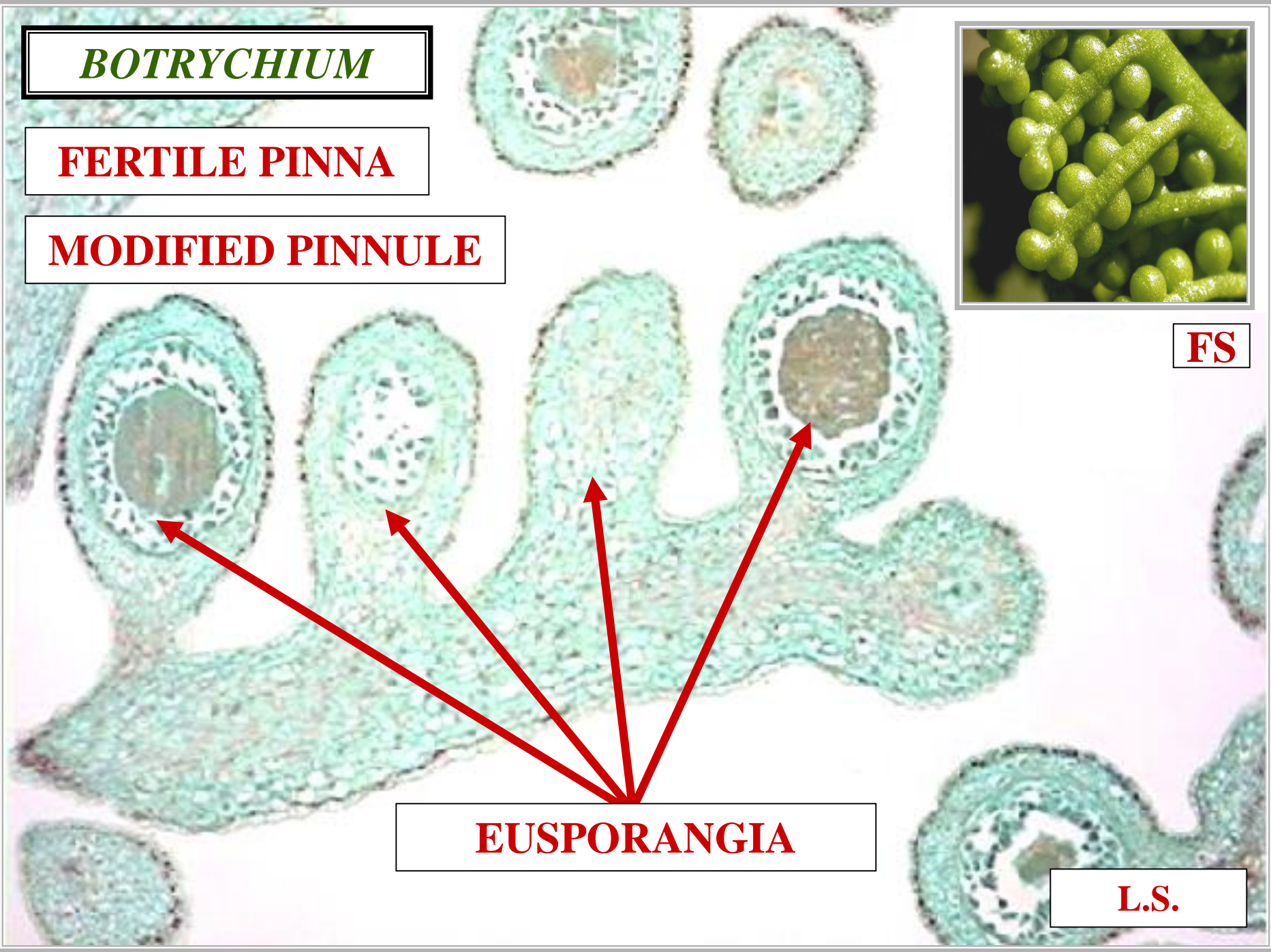
MODIFIED PINNULE



FS

EUSPORANGIA

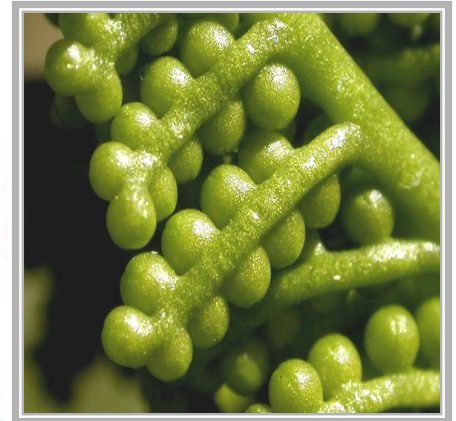
L.S.



BOTRYCHIUM

FERTILE PINNA

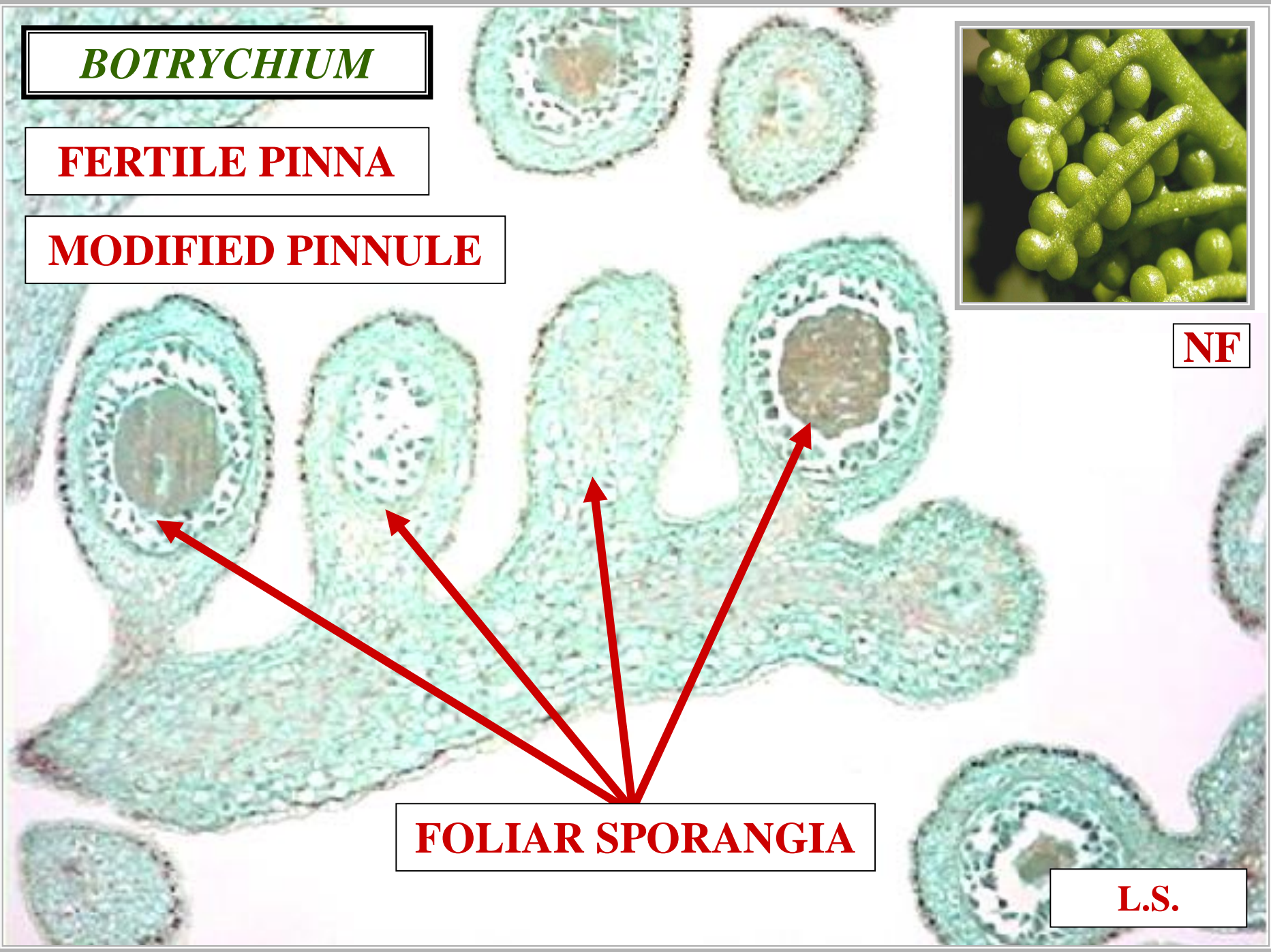
MODIFIED PINNULE



NF

FOLIAR SPORANGIA

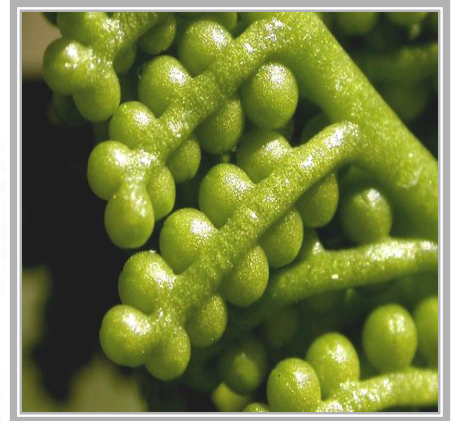
L.S.



BOTRYCHIUM

FERTILE PINNA

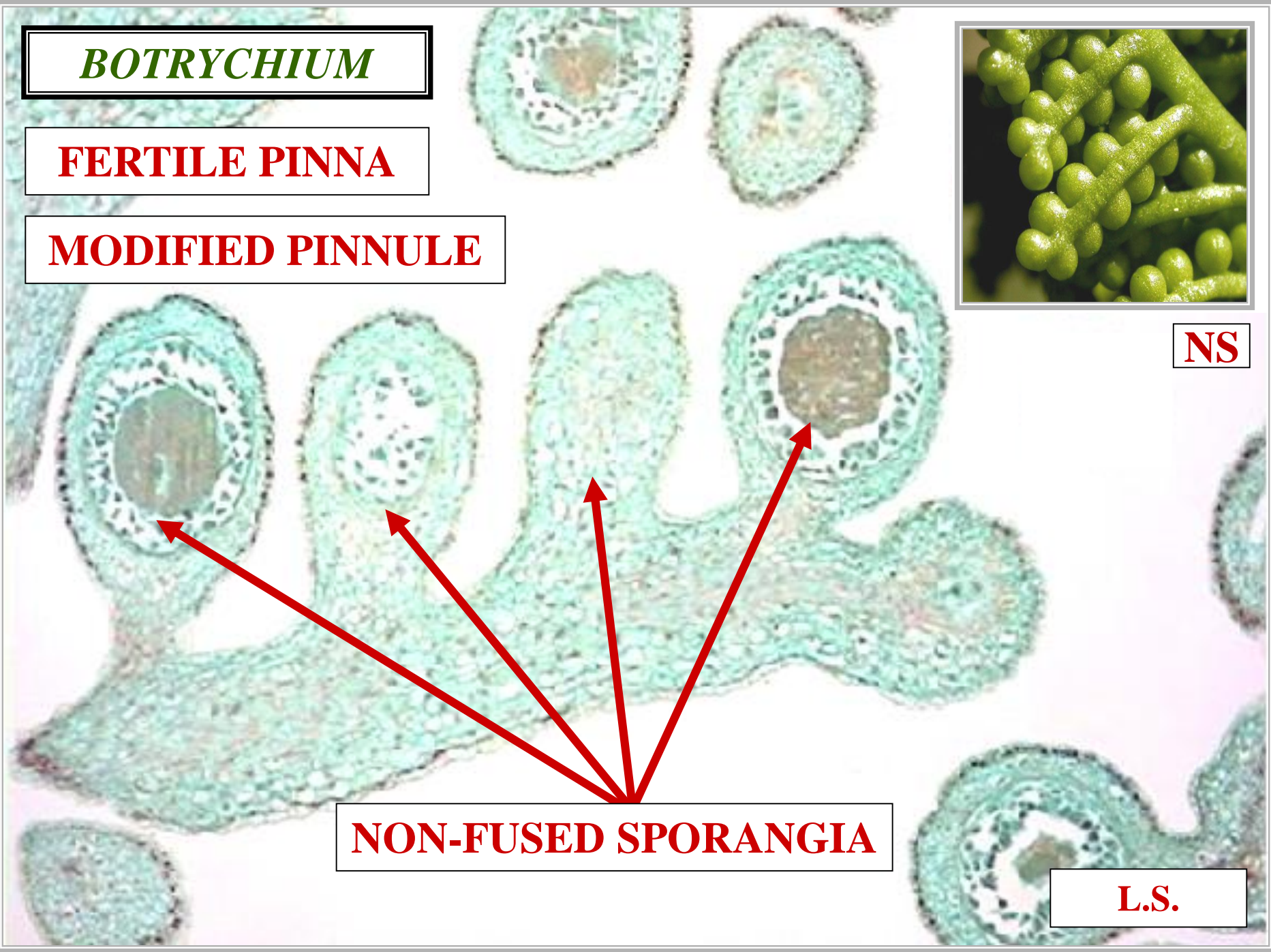
MODIFIED PINNULE



NS

NON-FUSED SPORANGIA

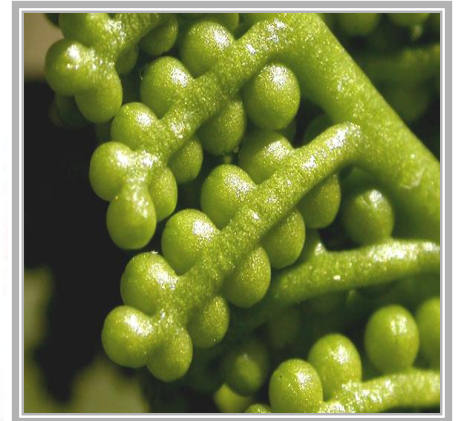
L.S.



BOTRYCHIUM

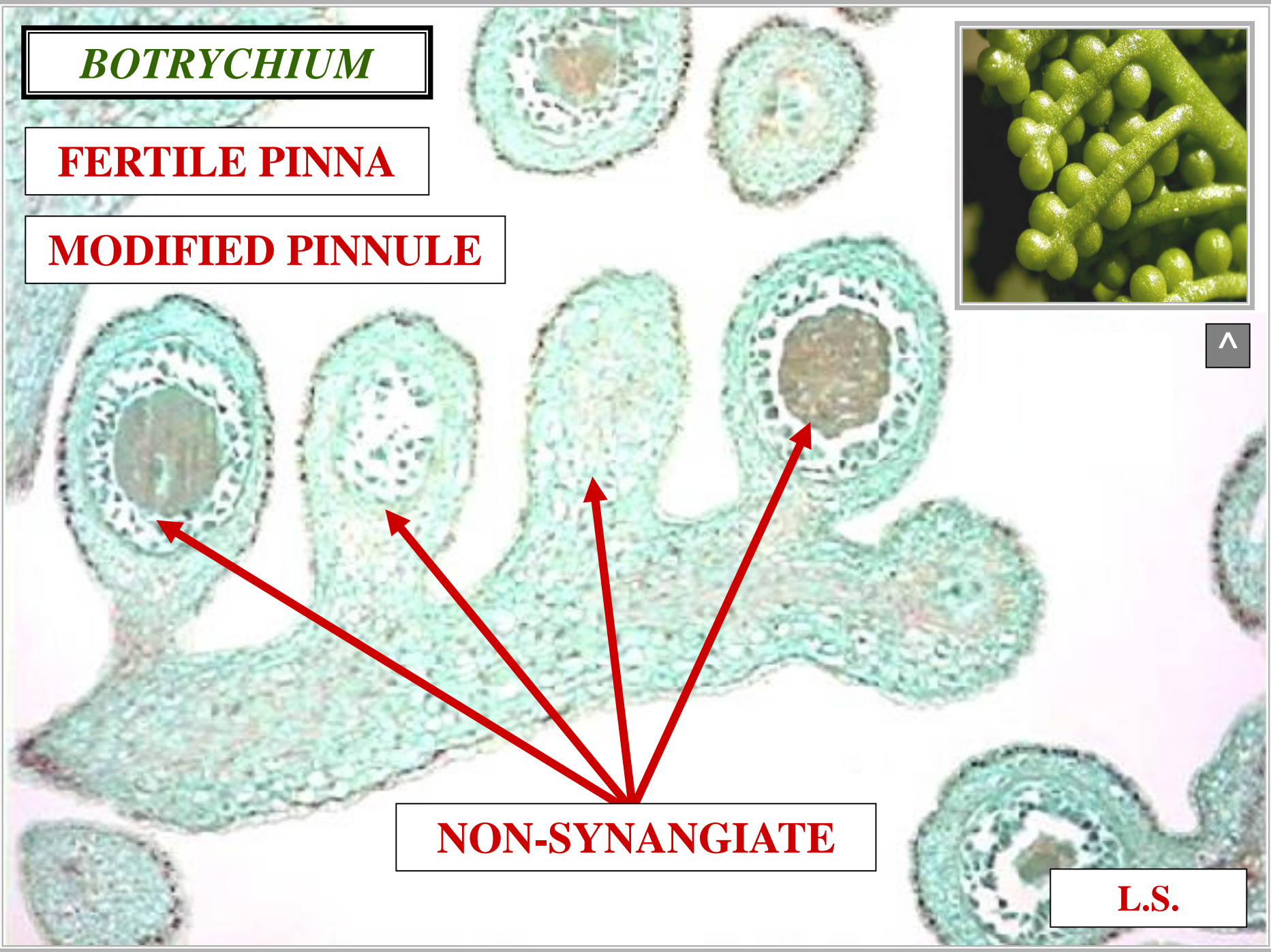
FERTILE PINNA

MODIFIED PINNULE



NON-SYNGIATE

L.S.





SPORE HABIT

BOTRYCHIUM

SPORES

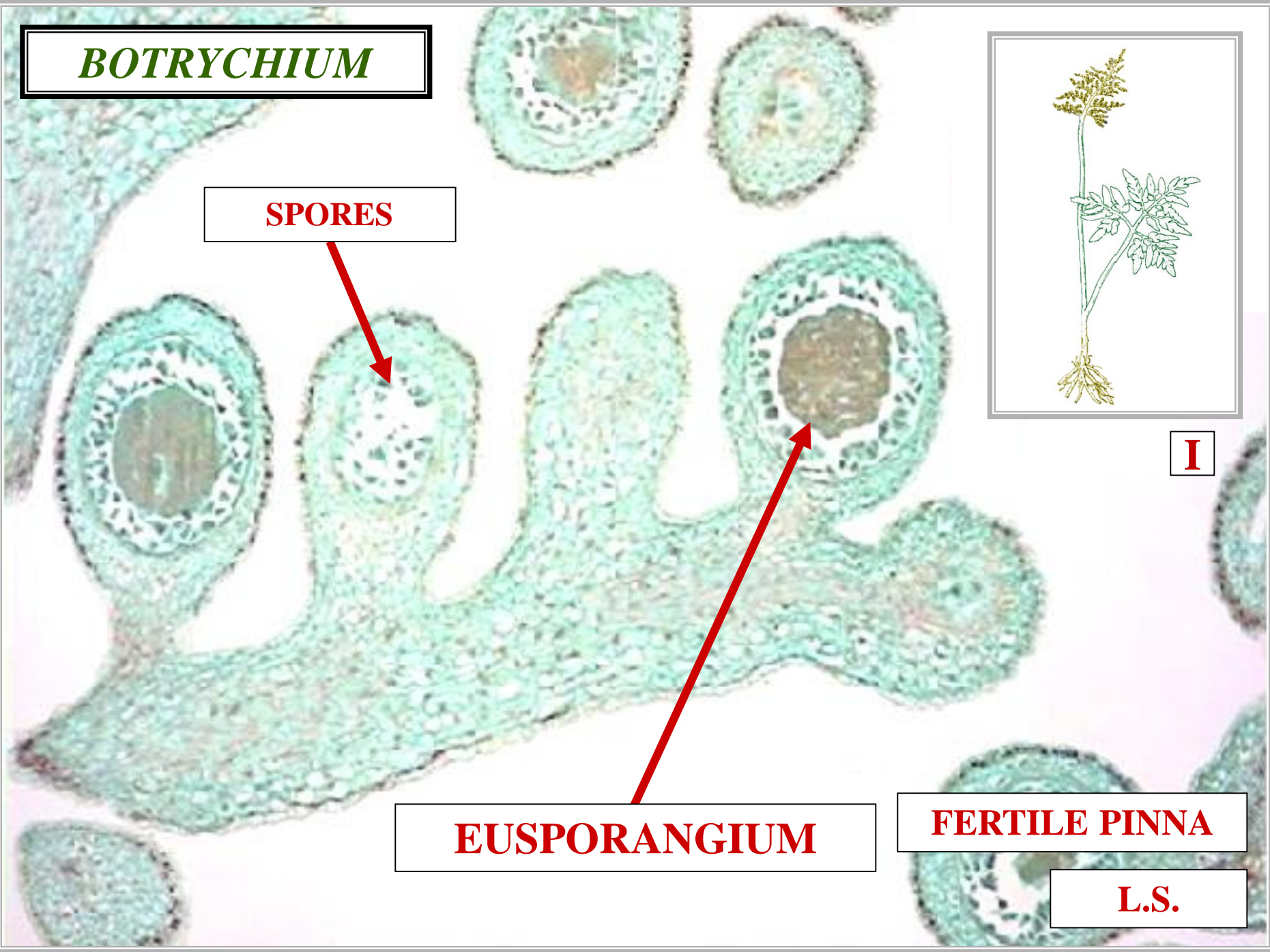
EUSPORANGIUM

FERTILE PINNA

L.S.



I



BOTRYCHIUM

ISOSPORES

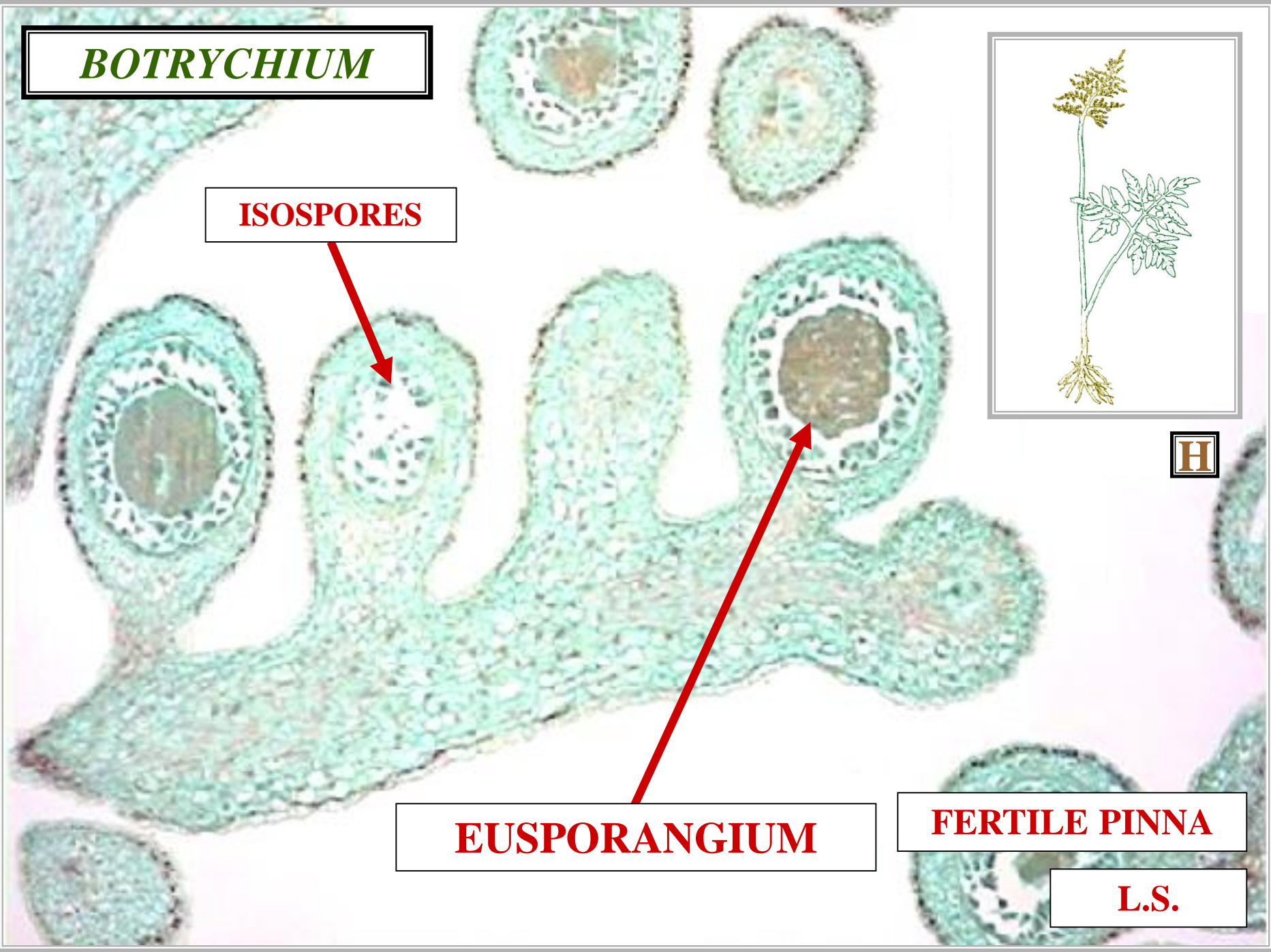
EUSPORANGIUM

FERTILE PINNA

L.S.

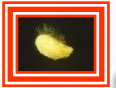


H



BOTRYCHIUM

ISOSPORES



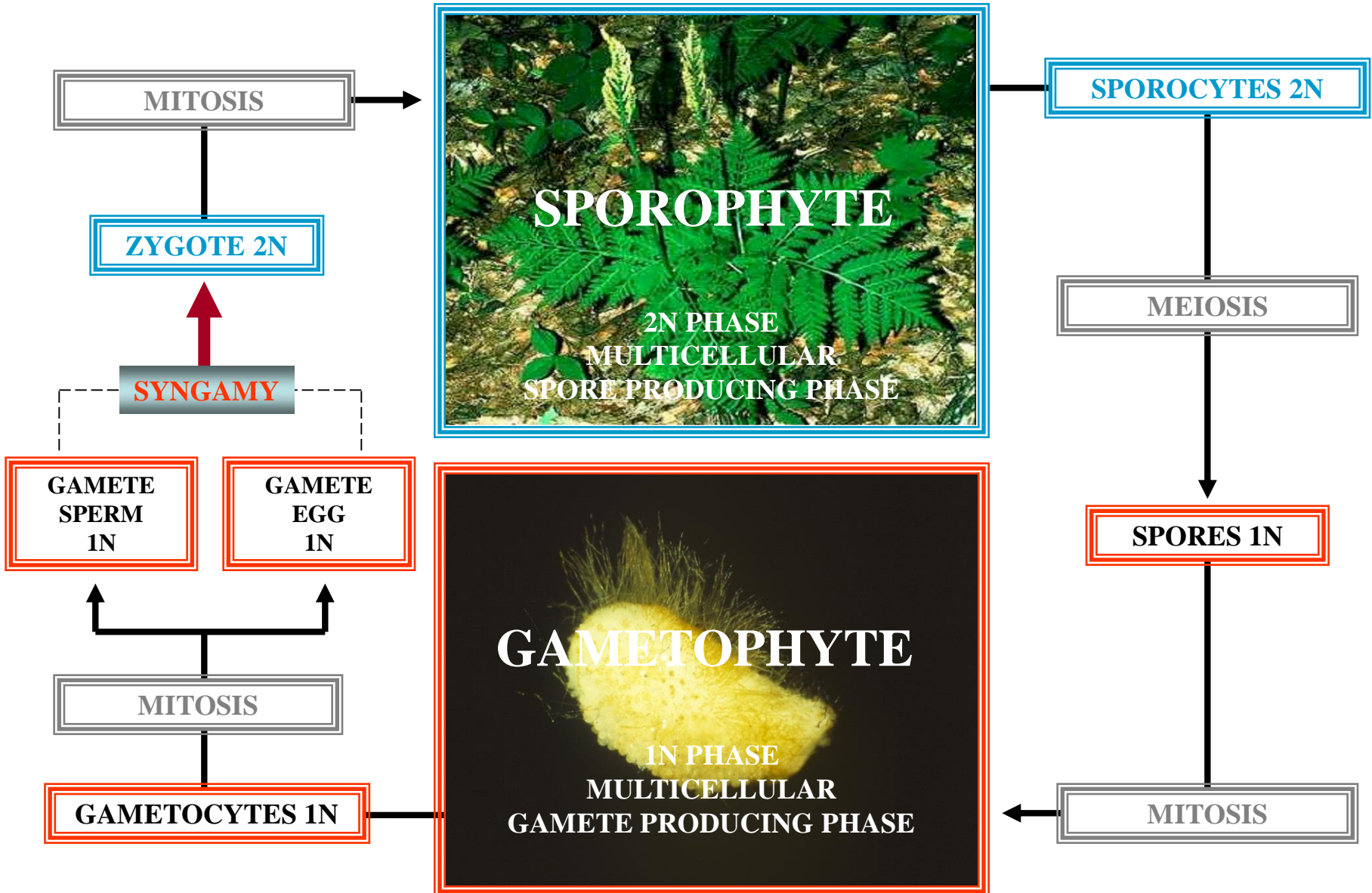
FERTILE PINNA

HOMOSPOROUS

L.S.

OPHIOGLOSSALES

LIFE CYCLE





GAMETOPHYTE CHARACTERS

BOTRYCHIUM

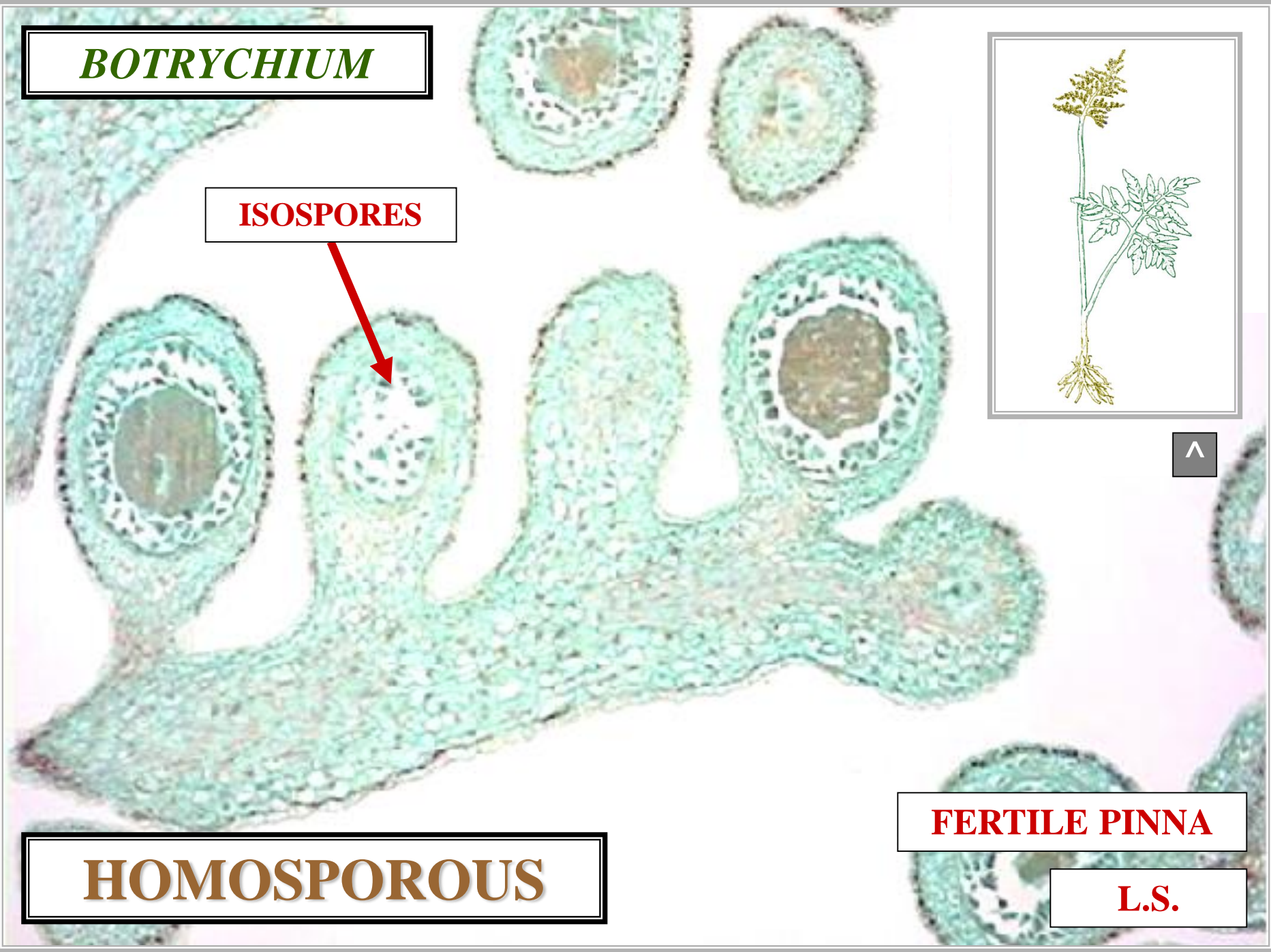
ISOSPORES



FERTILE PINNA

HOMOSPOROUS

L.S.





EXOSPORIC GAMETOPHYTE

S

BOTRYCHIUM

GAMETOPHYTE



EXOSPORIC

N

BOTRYCHIUM

GAMETOPHYTE



SUBTERRANEAN

M

BOTRYCHIUM

GAMETOPHYTE



NON-PSYN

EX

BOTRYCHIUM

GAMETOPHYTE



MYCORRHIZAE ABUNDANT

B

BOTRYCHIUM

GAMETOPHYTE



EXOSPORIC