
ME SCENE DO NOT CROSS CRIME SCENE DO NOT CROSS CRIME SCENE DO NOT CROSS CRIME SCENE D

CSI: Forensic Botany

- Text: *Coyle*
- Professor William L. Crepet wlc1
- TA, Azra Twombley Ellis act228
- Office Hours—call or email for meeting (Mann 408 or Emerson 232)
- Game Plan—flexible: movie nights, lectures, visits to appropriate facilities, student led discussions, prosecution v. defense exercises etc.
- Grading—class generated quizzes, participation in class, class presentations, midterm and final
- Keep your eyes on the calendar

Rough and Malleable distribution of grade percentages

- Quizzes- 20%
- Participation/Exercises 35%--flexible
- Midterm 15%
- Final 20%
- Attendance 10%--will be monitored

First Assignment

- Read the following Jasanoff essay in the next week or so

https://direct.mit.edu/daed/article/147/4/15/27218/Science-Common-Sense-amp-Judicial-Power-in-U-S

- Read the the first two chapters in the Coyle text

Course Organization—Will Evolve with your input, but will or may include:

- Individual and group presentations—facts of the case, role of plant evidence in defense or prosecution etc.
- Divide the class into groups
- Discussions of cases including prosecution and defense--jurys
- Quiz questions and quiz answers by students—part of course
- Movies—following leading law school movie choices that illustrate relevant features of evidence etc.
- PowerPoint presentations for reference—will be on Canvas, but lectures will not generally be recorded--exception

Course organization 2024

We are making some changes that are based on both past experiences:

- In the order of student involvement in cases presentations exercises
- In utilizing AI tools

OK Let’s begin

In addition to crime solving, we will evaluate cases

There are two general kinds of cases

Criminal and Civil Cases:

- **Criminal Cases**
- Criminal cases involve enforcing public codes of behavior, which are codified in the laws of the state. In criminal cases, the government prosecutes individuals for violating those laws (in other words, for allegedly committing a crime). Punishment in criminal cases can include fines, community service, probation, prison, and the like.

- **Civil Cases**
- Civil cases involve conflicts between people or institutions such as businesses, typically over money. A civil case usually begins when one person or business (the "plaintiff") claims to have been harmed by the actions of another person or business (the "defendant") and asks the court for relief by filing a "complaint" and starting a court case. The plaintiff may ask the court to award "damages" (money to compensate the plaintiff for any harm suffered), or may ask for an "injunction" to prevent the defendant from doing something or to require the defendant to do something, or may seek a "declaratory judgment" in which the court determines the parties' rights under a contract or statute.

Now—a critical definition, What is Forensics?

- relating to or denoting the application of scientific methods and techniques to the investigation of crimes or as relevant to civil cases
- We will blend case histories with botanical evidence
- The format will evolve pending your feedback and discussions we will have—lectures, discussions, problem solving, lab exercises, guest speakers, visits to various facilities and instrumentation.

Increasing Utility of Botanical Evidence

- There are a significant and growing number of instances where plant based evidence—including algae, fungi and mosses—have been important in solving crimes and obtaining convictions.
- We will mostly be looking at criminal cases but civil cases will also be considered as appropriate and can be selected by the class for review as appropriate

Sources of evidence

- We will concentrate on higher plant evidence because it is the most commonly used but some exciting cases involving other forms of plant evidence and we will have interesting guest lecture on mosses
- Vascular plants
- Algae
- Fungi
- Bryophytes

What can plant evidence tell us about a crime or other event where facts are being determined as part of an investigation or trial?

- Where the crime took place—if not at the same location as the victim
- If the suspect (s) was/were at the scene of the crime
- Various circumstances about the crime itself—the nature of the crime
- When the crime occurred –at various time scales, within hours etc.
- If a civil case as revealing facts relevant to the case

Forensic Botany as a Tool

- There has to be information in the plant material found in association with a crime or event under contention
- What kind of information we shall see
- What characteristics of plants provide that information?
- What are rules of evidence affecting botanical evidence of various kinds?

Forensic Botany

- What are the characteristics of plants that make forensic botany a valuable tool?
- What are the techniques we use to interpret what the plants are trying to tell us at a murder scene

Features of Plants relevant to Why Forensic Botany is potentially valuable.

Several Key Factors

- Dispersability—leaves, fruits, pollen flowers, trichomes (hairs), algae
- Growth patterns and rates, substrates, e.g. mosses, roots of vascular plants
- Specificity—to taxon, to location, to individual (distinctiveness—numbers of characters (including wood) or DNA or chemistry)
- Durability—likelihood of preservation or timing in digestion

We will address these issues, but it requires some basic knowledge of Plants

- Anatomy and morphology
- Taxon Identifiability from the evidence
- Implied Locations—ecology of their habitats
- Life cycles—times during the year when various organs are available
- Nature of various organs, their dispersibility and propensity to preserve under variable conditions
- Growth patterns

Why Me in This course?

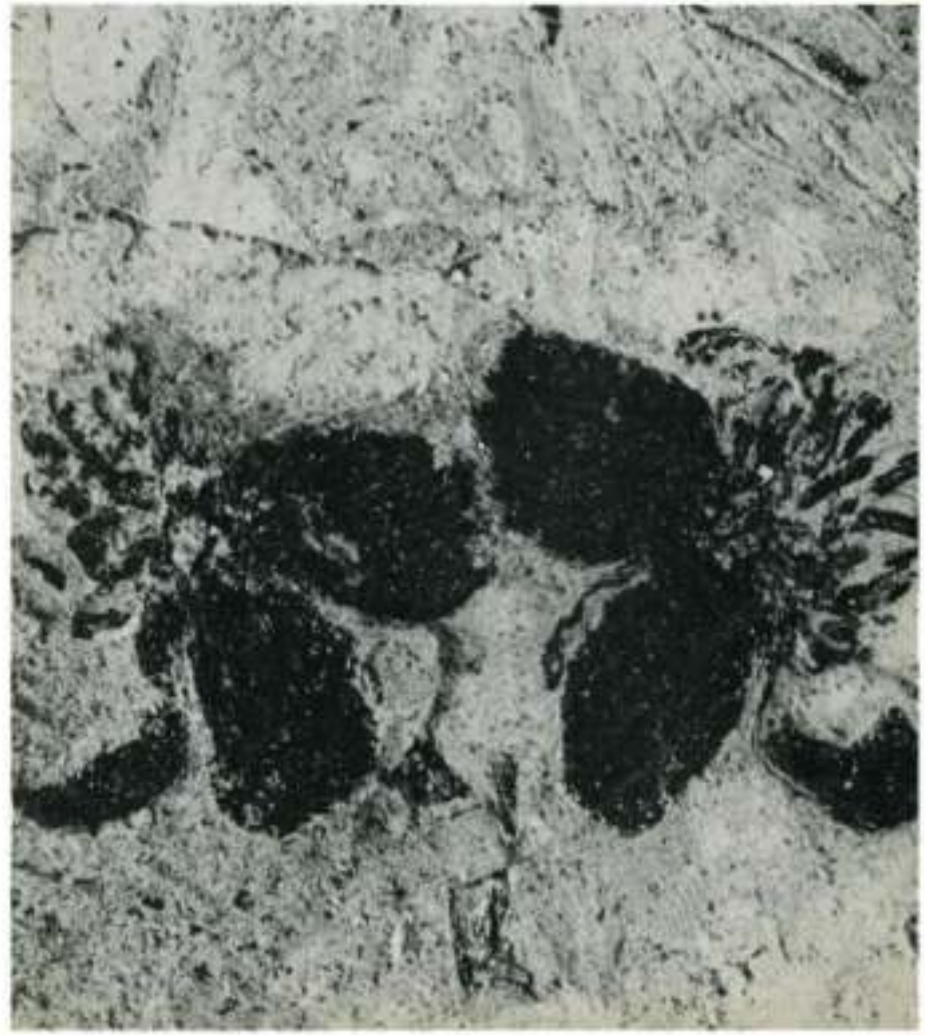
- Well, in addition to my relevant experience, it is related to the nature of my research—identifying plants and their significance by evaluating fragmentary evidence
- I will bring in some fun and important guests, really world class ones, with specific expertise or case histories
- Several aspects of my background and interest that hav led me to this course and I do not mind personalizing these

I am after all and evolutionary biologist and paleontologist although I have been an administrator at various levels

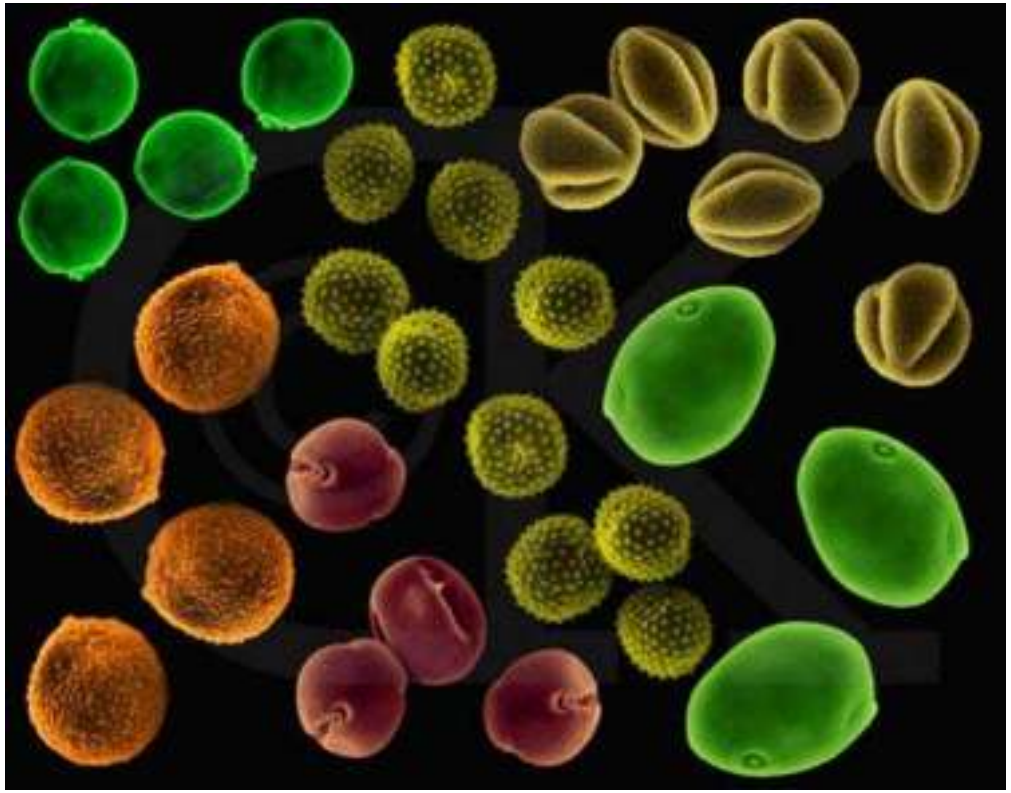
- Let’s begin with how my science relates to forensic botany

Paleobotany

SCIENCE
30 August 1974
Vol. 185, No. 4155
AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE



Palynology




VOGUE
185
GREAT DAY
LOOKS
The New Suit
Sexy & Chic
Leathers
RED
RULES
Fall's
Favorite
Color
THER
UGHTER
FACELIFT
HAEL
KORS
The Triumph
of American
Style

Science Times

The New York Times

In Tiny Fossils, Botanists See Flowery World

Insects like the Meliponinni bee may have evolved along with Cretaceous-era flowers whose fossils were recently discovered in New Jersey.

Empty Lot Yields Trove of Ancient Plants

Jennifer Stokes/Cornell University

Michael Rothman

The Paleoclusia chevalieri, above and in electron microscope image to left, could have been pollinated by the Meliponinni bee. Its modern relative, the Clusia gaudichaudii, is at right.

Illustrations by Michael Rothman

By CAROL KAESUK YOON

mutual and explosive diversification

Jackson Pollock Convergence Albright-Knox Art Gallery


#1
Recommended
by Dermatologists
Allergists
Pediatricians
for Sensitive Skin
all
with stainlifters
free clear
of perfumes
of dyes
31
LOADS


CHENANGO COUNTY COURT HOUSE

THE EVENING SUN

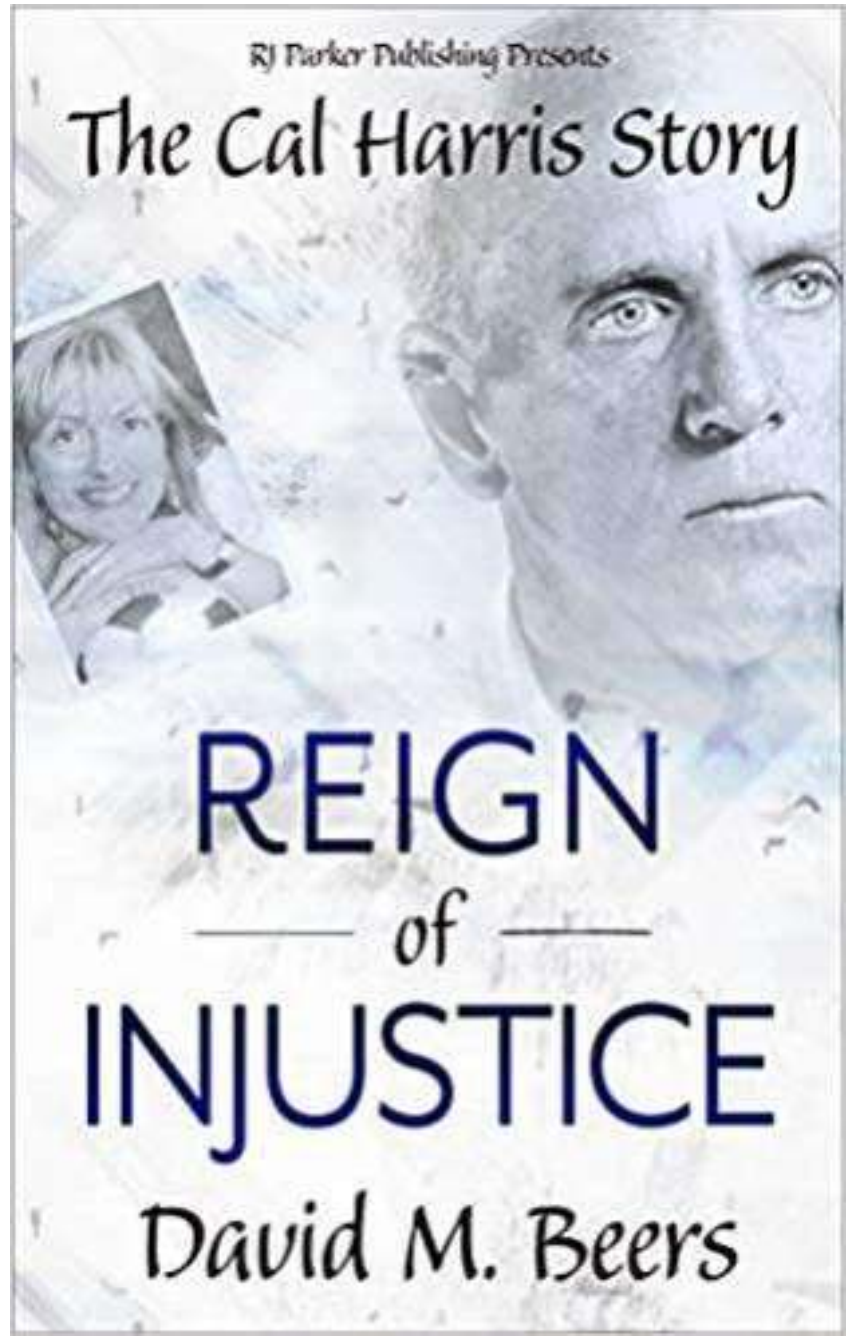
Defense Begins Its Testimony On Day 11 Of The Wlasiuk Murder Trial

Published: June 27th, 2012

By: Shawn Magrath

NORWICH –

First on the stand for the defense, Cornell University Professor of Plant Biology Dr. William Crepet


RJ Parker Publishing Presents
The Cal Harris Story
REIGN
of
INJUSTICE
David M. Beers

Now on to the botanical Evidence

HOW DO WE “READ” THE BOTANICAL EVIDENCE

- WE USE INSTRUMENTS AND WE USE REFERENCE COLLECTIONS AND OTHER FACILITIES
- COMPUTER ALGORITHMS
- HAVE KNOWLEDGE OF PLANT DIVERSITY AND OF THE CHARACTERISTICS OF DIFFERENT PLANT GROUPS THAT MAY BE RELEVANT
- THE CONTEXT—ANATOMY, REPRODUCTIVE BIOLOGY LIFE CYCLES, BIOGEOGRAPHY, MOLECULAR GENETICS, PLANT BIOCHEMISTRY

Weill Hall

Turonian Ericales

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Ferns S.L.
Cycadales
Ginkgoales
Pinales
Gnetales
Amborellales
Nymphaeales
Austrobaileyales
Chloranthales
Magnoliales
Laurales
Canellales
Piperales
magnoliids
Acorales
Alismatales
Petrosaviales
Dioscoreales
Pandanales
Liliales
Asparagales
Unplaced
Arecales
Poales
Commelinales
Zingiberales
commelinids
monocots
Ceratophyllales
Ranunculales
Sabiales
Proteales
Trochodendrales
Buxales
Gunnerales
Berberidopsidales
Dilleniales
Caryophyllales
Santalales
Saxifragales
Vitales
Unplaced
Crossosomatales
Geraniales
Myrtales
Unplaced
Zygophyllales
Celastrales
Oxalidales
Malpighiales
Cucurbitales
Fagales
Fabales
Rosales
rosid I
rosids
rosid II
Sapindales
Huerteales
Malvales
Brassicales
eudicots
core eudicots
asterids
Cornales
Ericales
Unplaced
Garryales
Unplaced
Gentianales
Lamiales
Solanales
asterid I
Aquifoliales
Unplaced
Asterales
Unplaced
Dipsacales
Apiales
asterid II

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Where particular plants live is an important source of information

- **Biome—**A biome describes the world's major communities of living things. Biomes are classified according to the predominant vegetation (plants) and characterized by adaptations of organisms (animals) to that particular environment and a biome may include several habitats.
- **Habitats**—specific places where animals and plants normally live
- **Microhabitats**—A habitat can be subdivided into regions with different environmental conditions. These subdivisions are called microhabitat. For example, in a pond, some organisms are surface dwellers while some others are bottom dwellers
- **Niches**--G.E. Hutchinson suggested that the niche could be modelled as an imaginary space with many dimensions, in which each dimension or axis represents the range of specific environmental condition or resource that is required by the species. Thus, the niche of a plant might include the range of temperatures that it can tolerate, the intensity of light required for photosynthesis, specific humidity regimes

Savannah

Temperate Forest

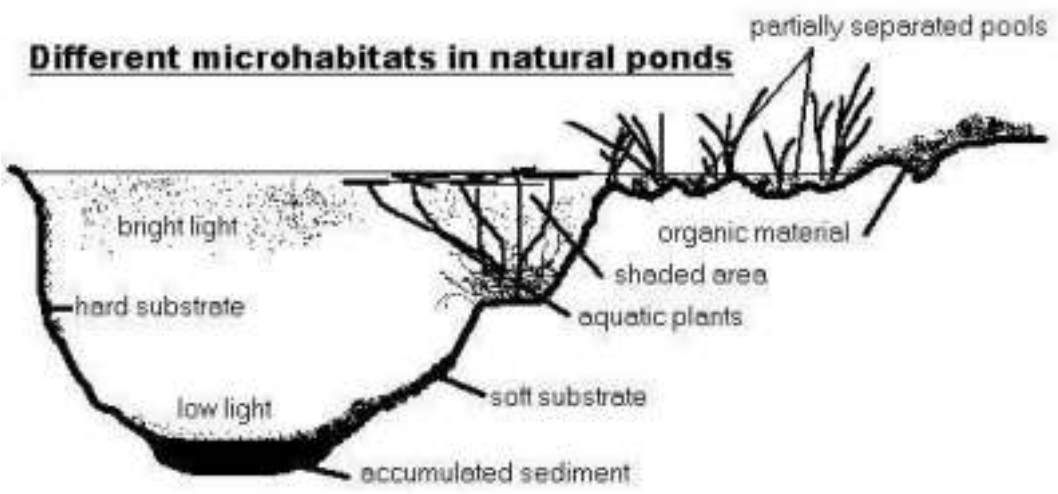
Tropical Rainforest

Desert

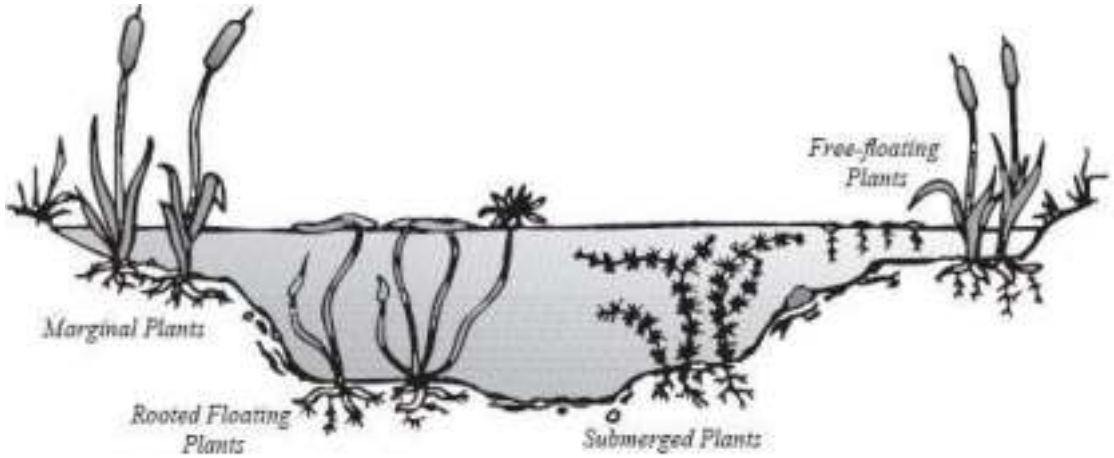
Mountain

Coastline

Pond Habitat and Microhabitat



Pond Niches


Free-floating Plants
Marginal Plants
Rooted Floating Plants
Submerged Plants

WHAT IS THE NATURE OF BOTANICAL EVIDENCE?

- ASSOCIATED DISSEMINULES (What are disseminules)
- PLANT MATERIAL INVOLVED IN CRIME
- ASSOCIATED IN SITU PLANT MATERIAL
  - Plant growth rates
  - Plant substrate growth patterns
- CHEMICALS—POISONS, DRUGS
- PLANTS AFFECTED BY THE CIRCUMSTANCES OF THE CRIME

Key Plant Parts (Not chemical)in Forensics

- Wood—all year, but history of seasonality for years, built in
- Leaves—Seasonal or not, depending on the taxon
- Flowers--Seasonal
- Fruits--Seasonal
- Pollen—Seasonal

Forensic aspects of these plant Parts

- Basically the uniqueness of the plant part in question, its position in time and space—these provide or can provide a great deal of context in combination with the victim’s condition and association with plant parts and space. (This also applies or could apply to various chemicals)

How will we come to appreciate the nature of forensic evidence

- Well, we have to learn about plants and then review plants as evidence as we look into various cases

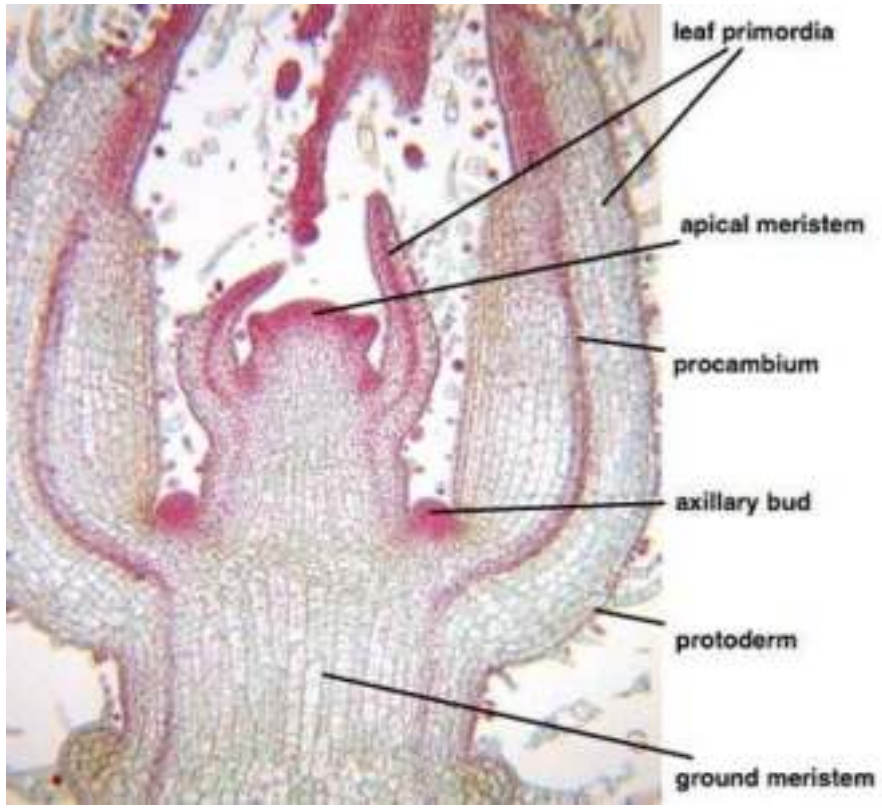
- What do we have to know about plants to understand their role in forensics?

Botanical Forensic Evidence

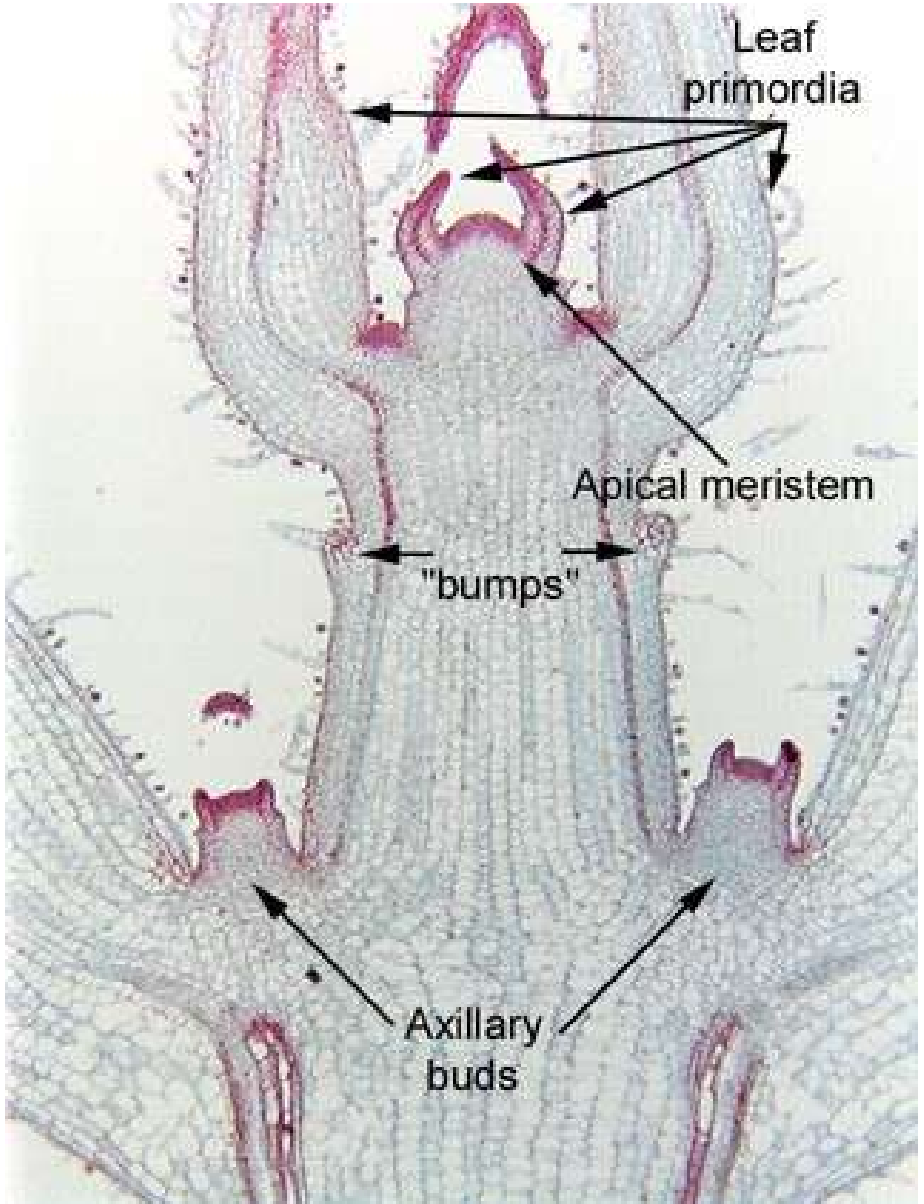
- Diversity/geography-distribution
- Structure
- Anatomy
- Biogeography
- Chemistry
- Molecular Genetics

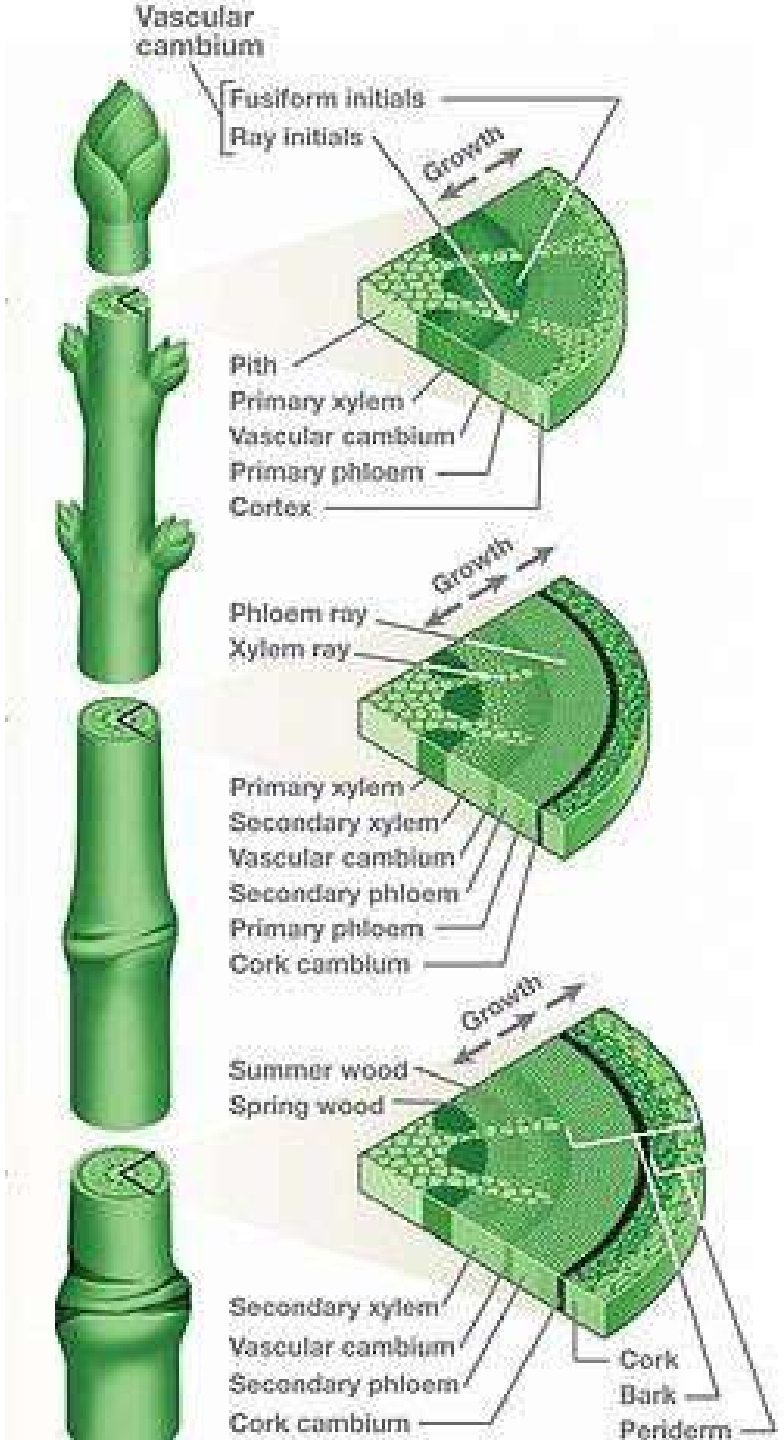
some relevant aspects of plants

Plant Basics



How do plants grow?




Vascular cambium
Fusiform initials
Ray initials
Growth
Pith
Primary xylem
Vascular cambium
Primary phloem
Cortex
Growth
Phloem ray
Xylem ray
Primary xylem
Secondary xylem
Vascular cambium
Secondary phloem
Primary phloem
Cork cambium
Growth
Summer wood
Spring wood
Secondary xylem
Vascular cambium
Secondary phloem
Cork cambium
Cork
Bark
Periderm

Types of Protostele

Types of Siphonostele

solenostele dictyostele eustele

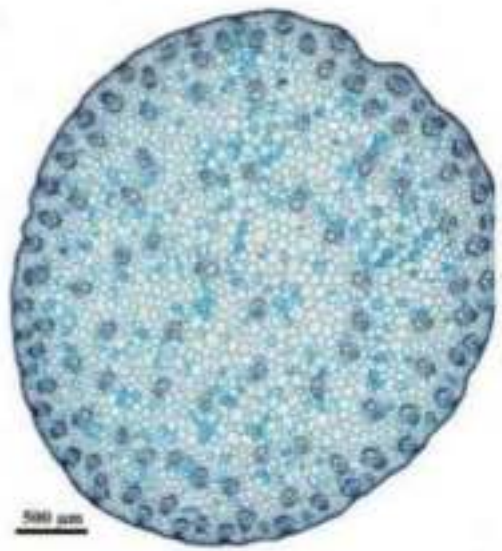
Types of Protostele

haplostele actinostele plectostele

PLANTS

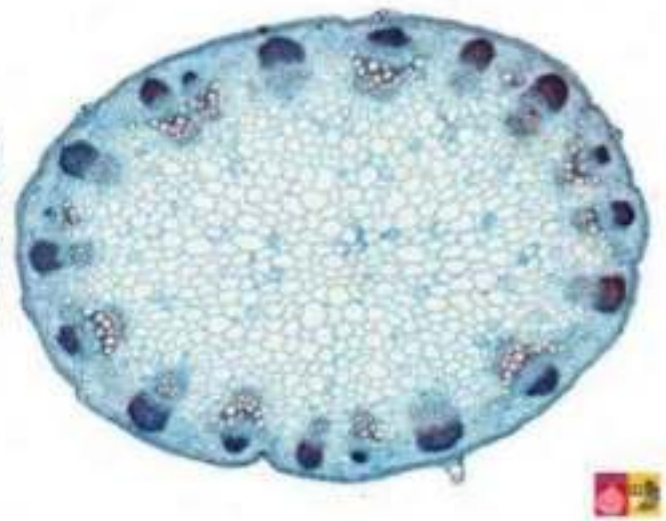
Monocots vs. dicots

Monocot stem

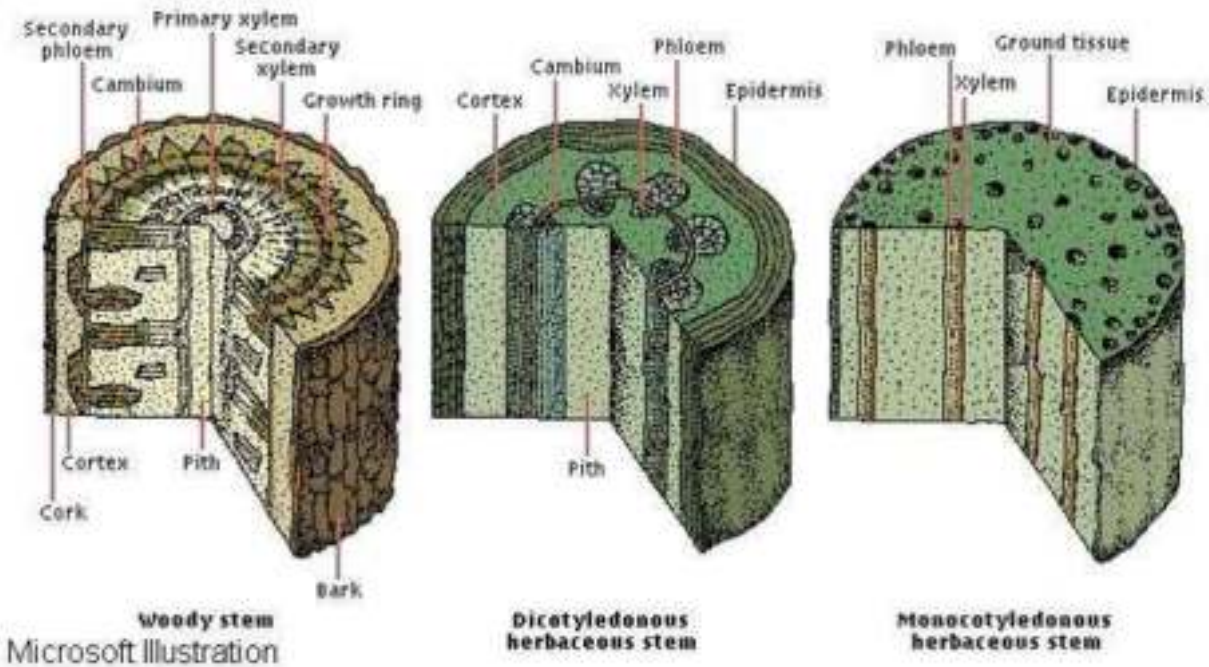


Primary vascular bundles scattered

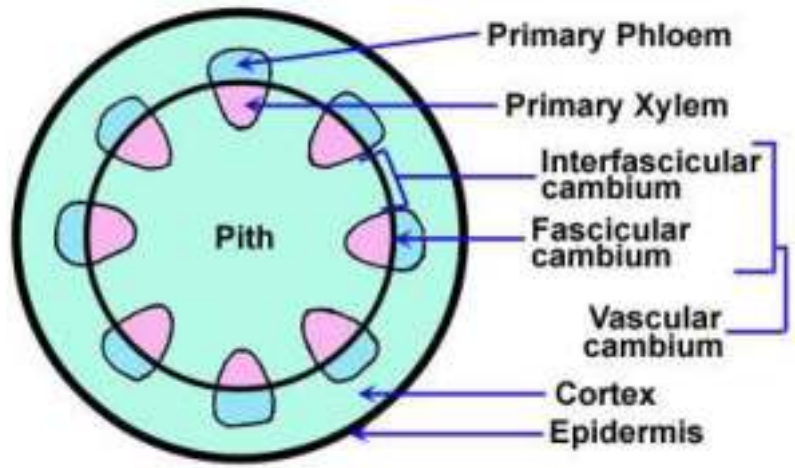
Dicot stem

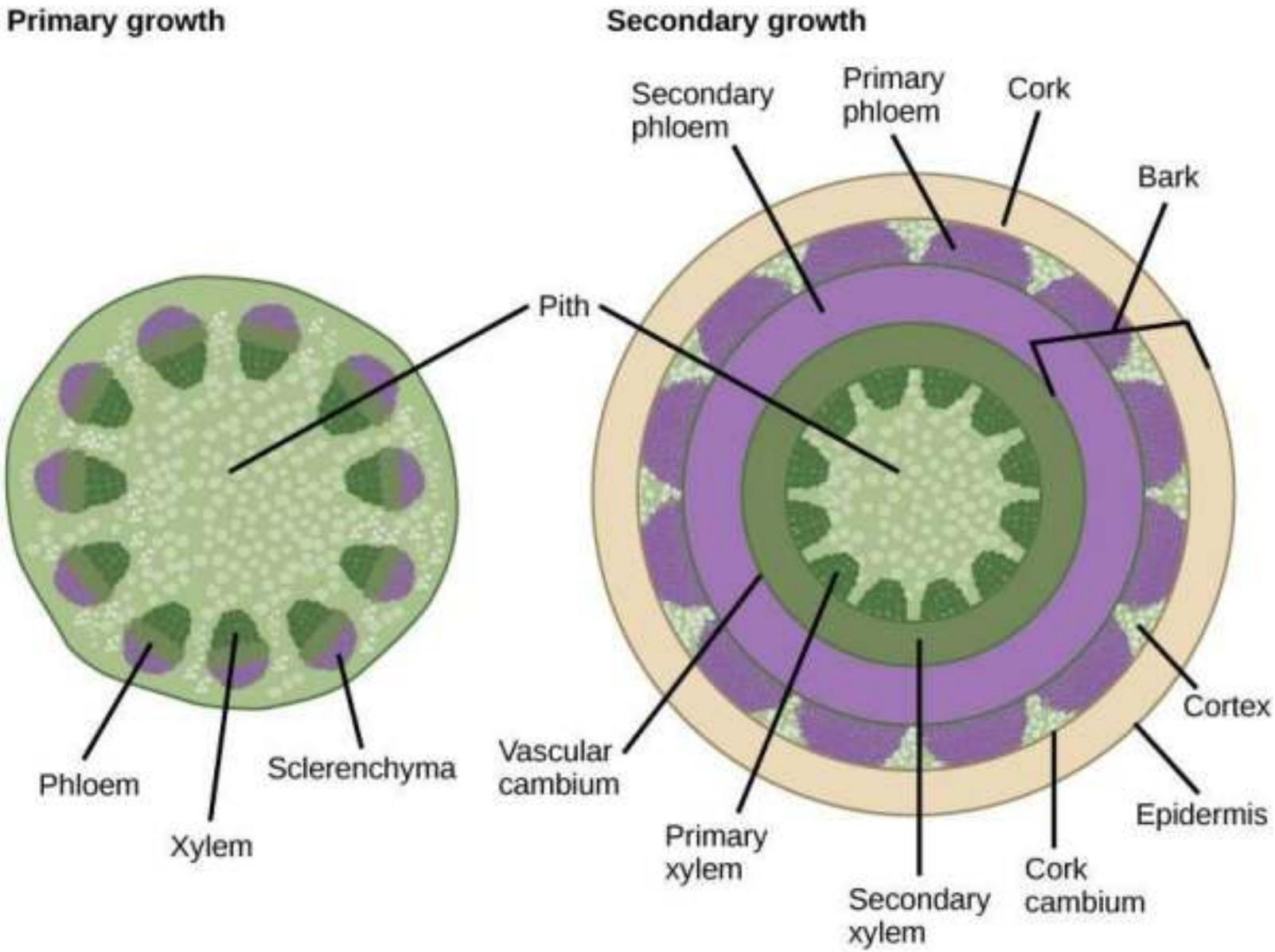


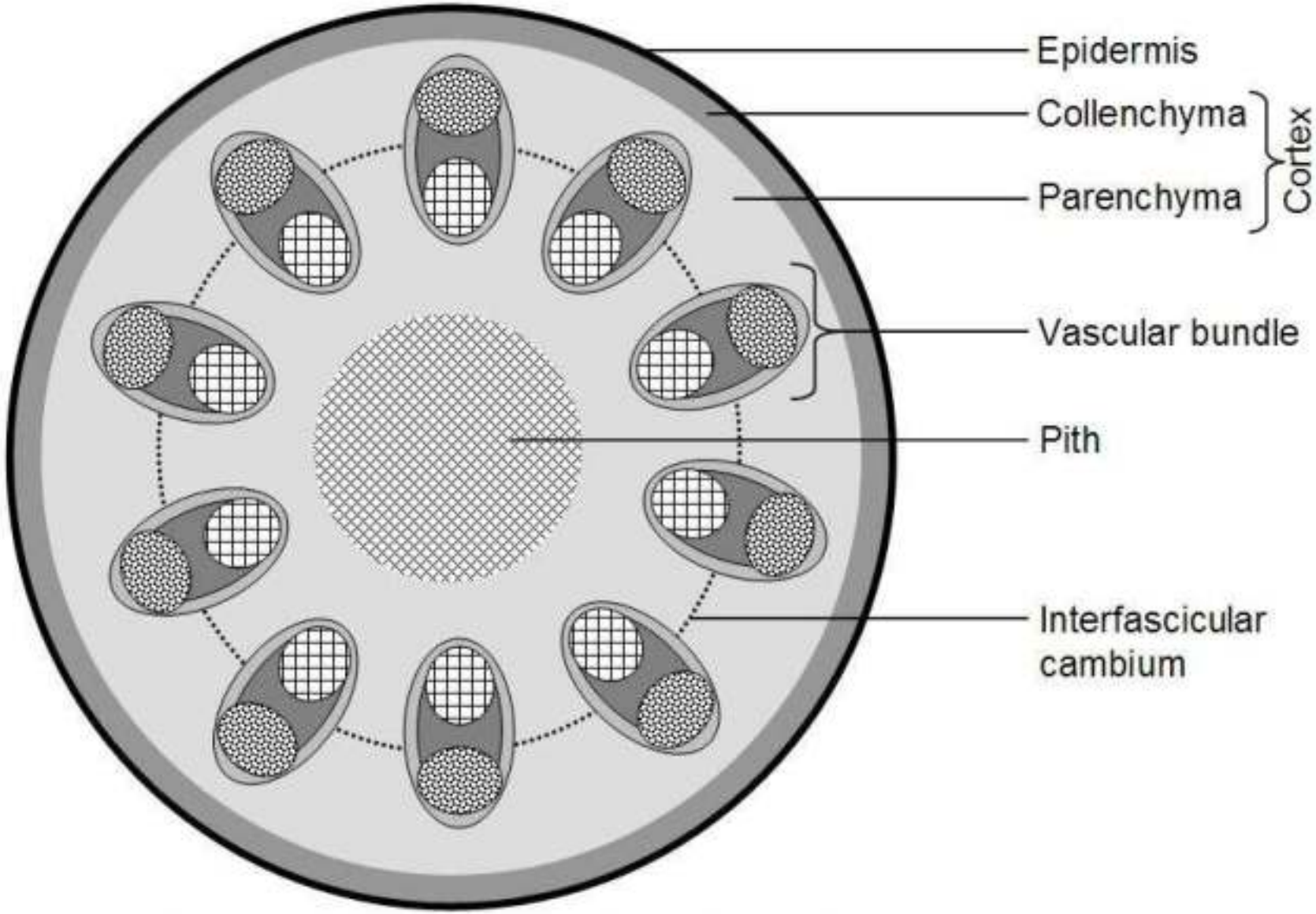
Primary vascular bundles in a ring



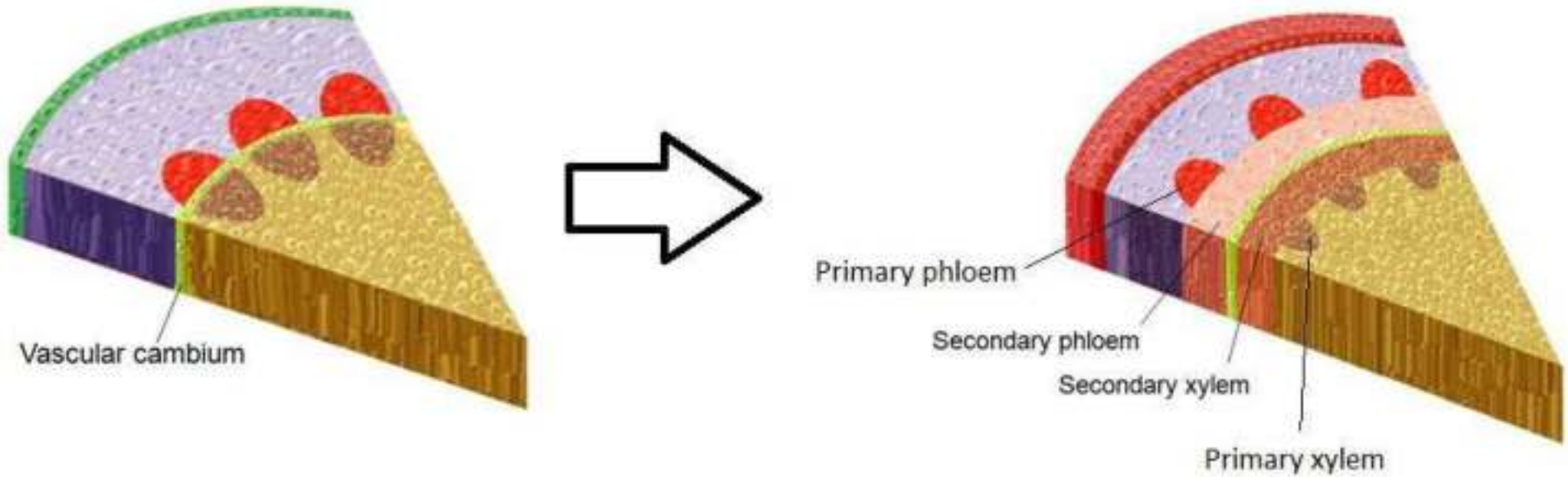
Microsoft Illustration


Primary Phloem
Primary Xylem
Interfascicular cambium
Fascicular cambium
Vascular cambium
Pith
Cortex
Epidermis

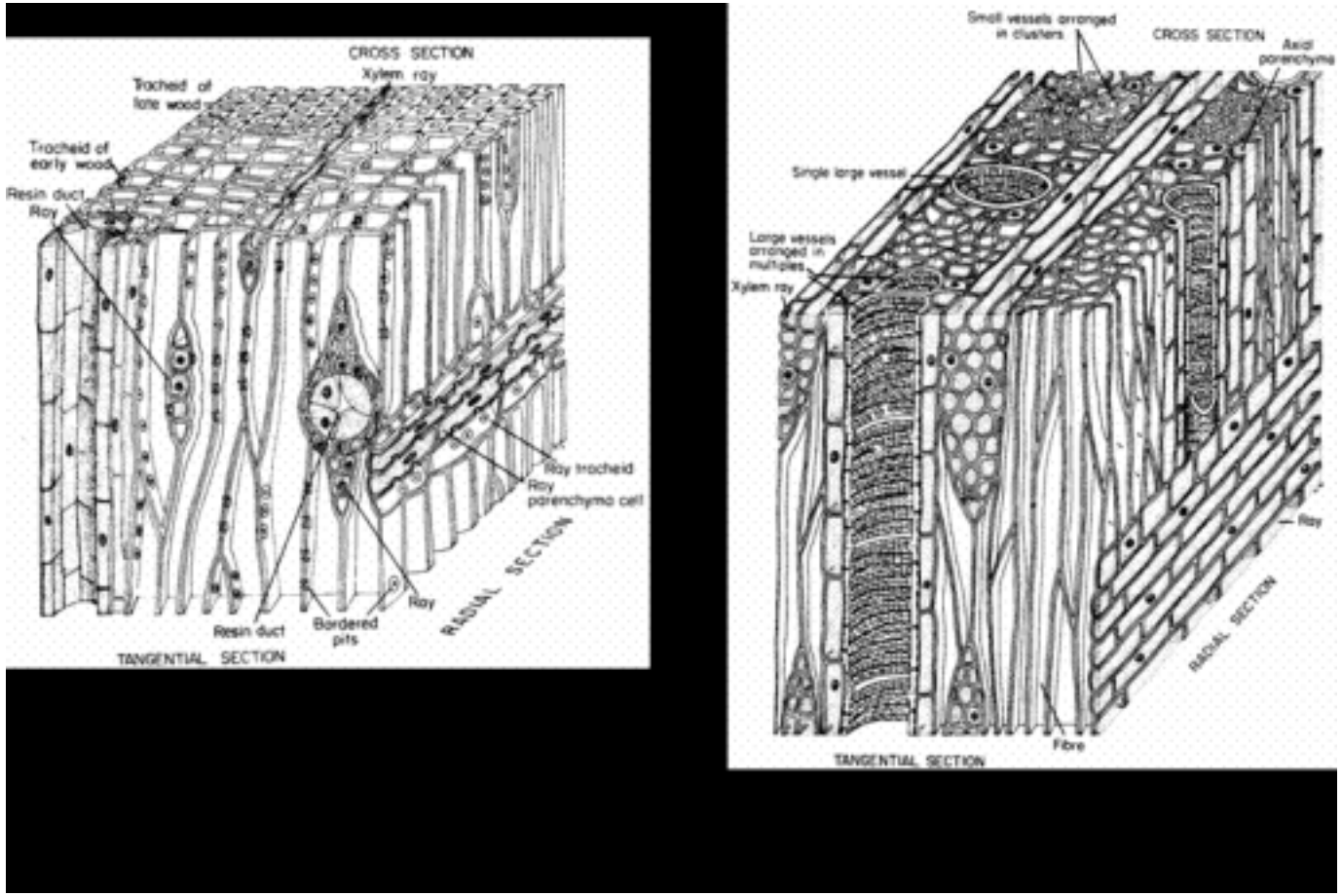

Primary growth
Secondary growth
Secondary phloem
Primary phloem
Cork
Bark
Pith
Phloem
Xylem
Sclerenchyma
Vascular cambium
Primary xylem
Secondary xylem
Cork cambium
Cortex
Epidermis

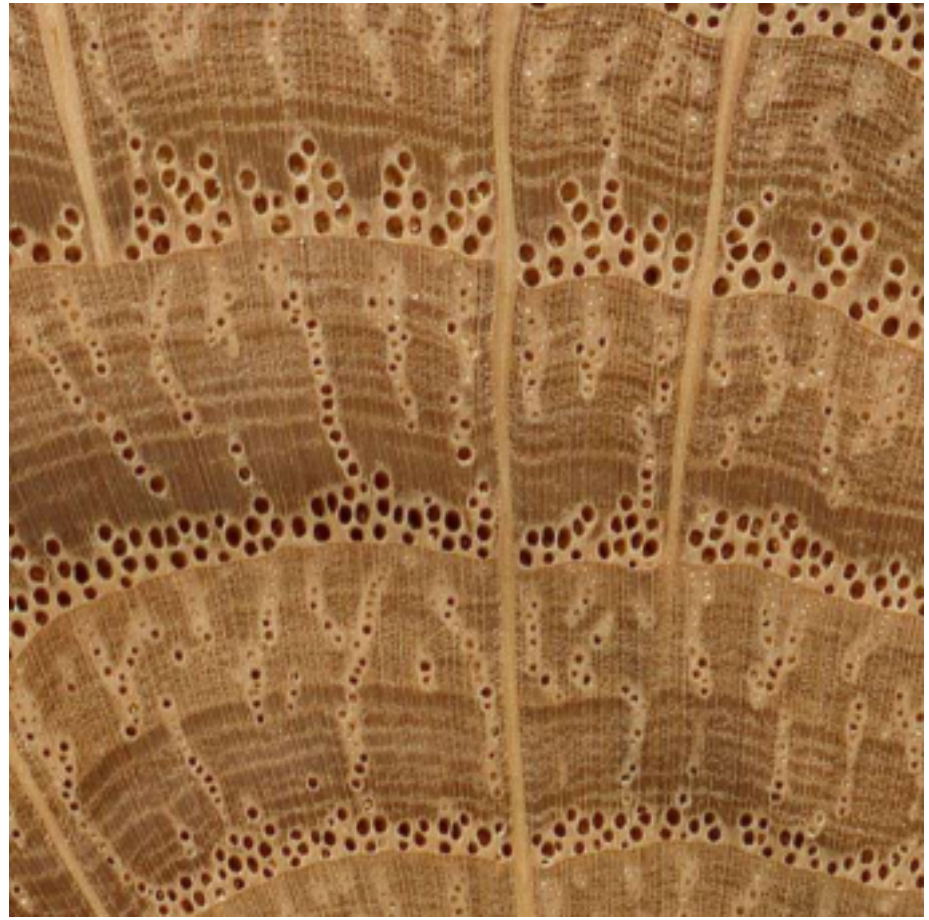


Cross-section through a young non-woody dicot stem


Vascular cambium
Primary phloem
Secondary phloem
Secondary xylem
Primary xylem


gettyimages
Ed Reschke


CROSS SECTION
Xylem ray
Tracheid of late wood
Tracheid of early wood
Resin duct
Ray
Ray tracheid
Ray parenchyma cell
RADIAL SECTION
Ray
Resin duct
Bordered pits
TANGENTIAL SECTION
Small vessels arranged in clusters
CROSS SECTION
Axial parenchyma
Single large vessel
Large vessels arranged in multiples
Xylem ray
Ray
RADIAL SECTION
Fibre
TANGENTIAL SECTION



Pinus resinosa

WOOD 280 – Macroscopic wood anatomy features

Grain

Knots

Figure

(CMSA) (Hoadley)

Pollen

So Far

- Introduced the basis for potential value of forensic plant evidence
- Introduced tools/reference facilities used to extract information from plant evidence—herbarium tour
- Introduced evolutionary and ecological context
- Introduced general aspects of plant form—including transition to woodiness in development

And….

- We have to have exposure to plant structure etc., but also to the tools and facilities we use to determine the salient aspects of plants
- Hence we will look at plant structure and morphology directly, we will learn how the herbarium is a useful resource, we will see how SEM microscopy is useful, Look at plant diversity in the Conservatory.
- And again, in our groups we will address cases, discuss them, debate the merits, all while looking directly at relevant plant evidence

Grading

- 30% on biweekly quizzes
- 40% Class discussion, exercises, participation etc.—adjusted to accommodate online students
- 15% midterm
- 15% final

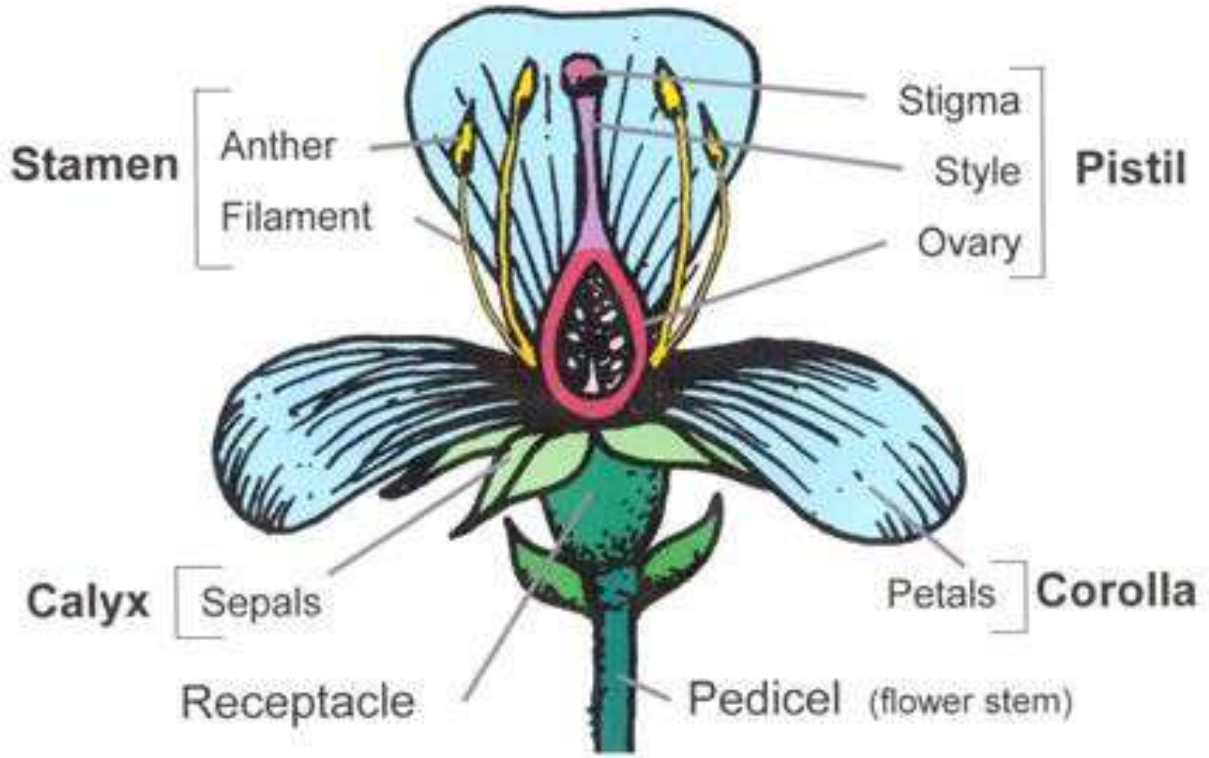
Practicalities…

- Movie night?
- Send availability
- Dropbox delivery today
- Guest lecture schedule and syllabus coming
- What will teaching be like (vignette)—establishment of working groups—and how they will work—
- Individual presentations/discussions—work through—4 we have to experiment here

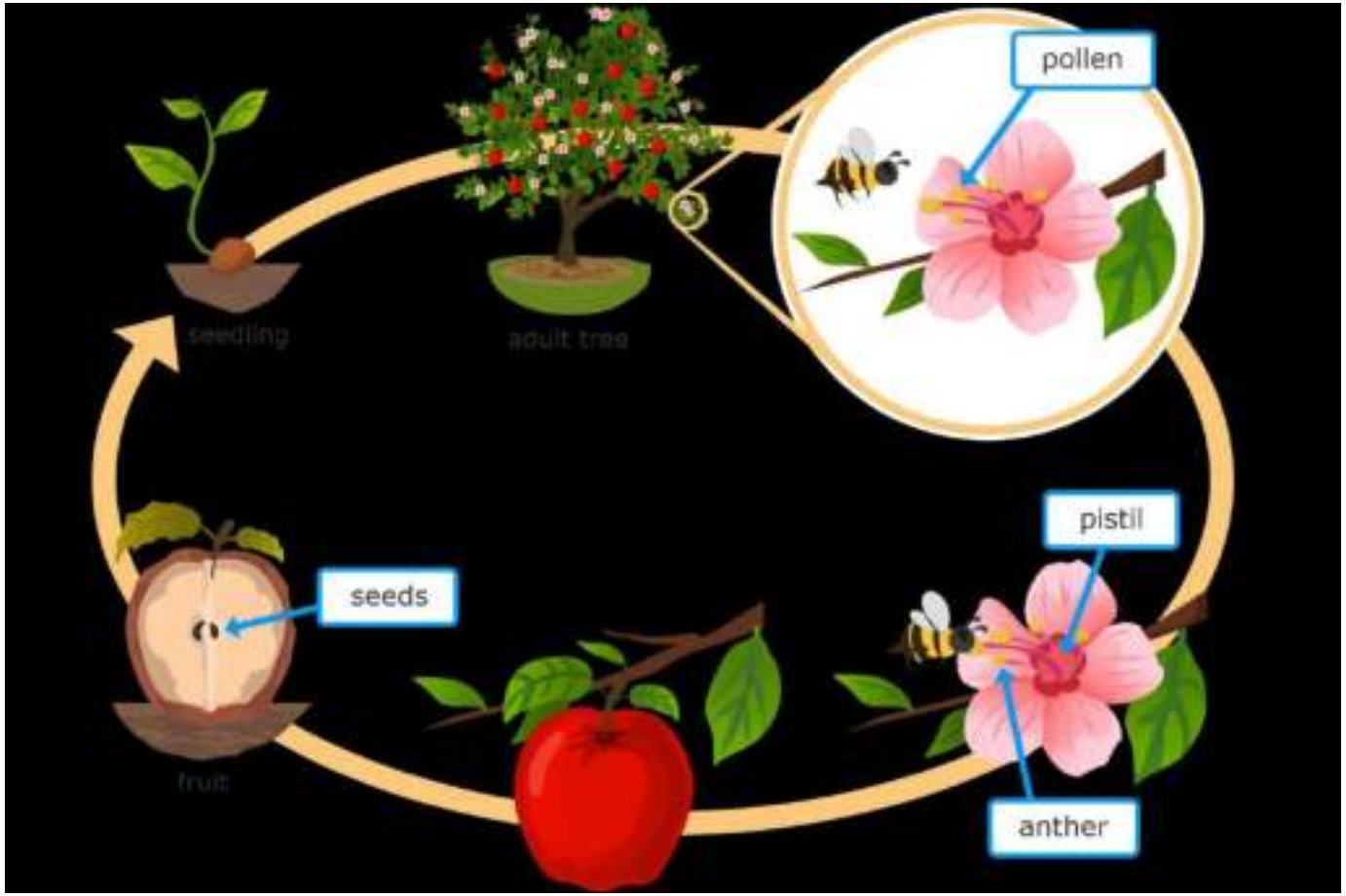
Now

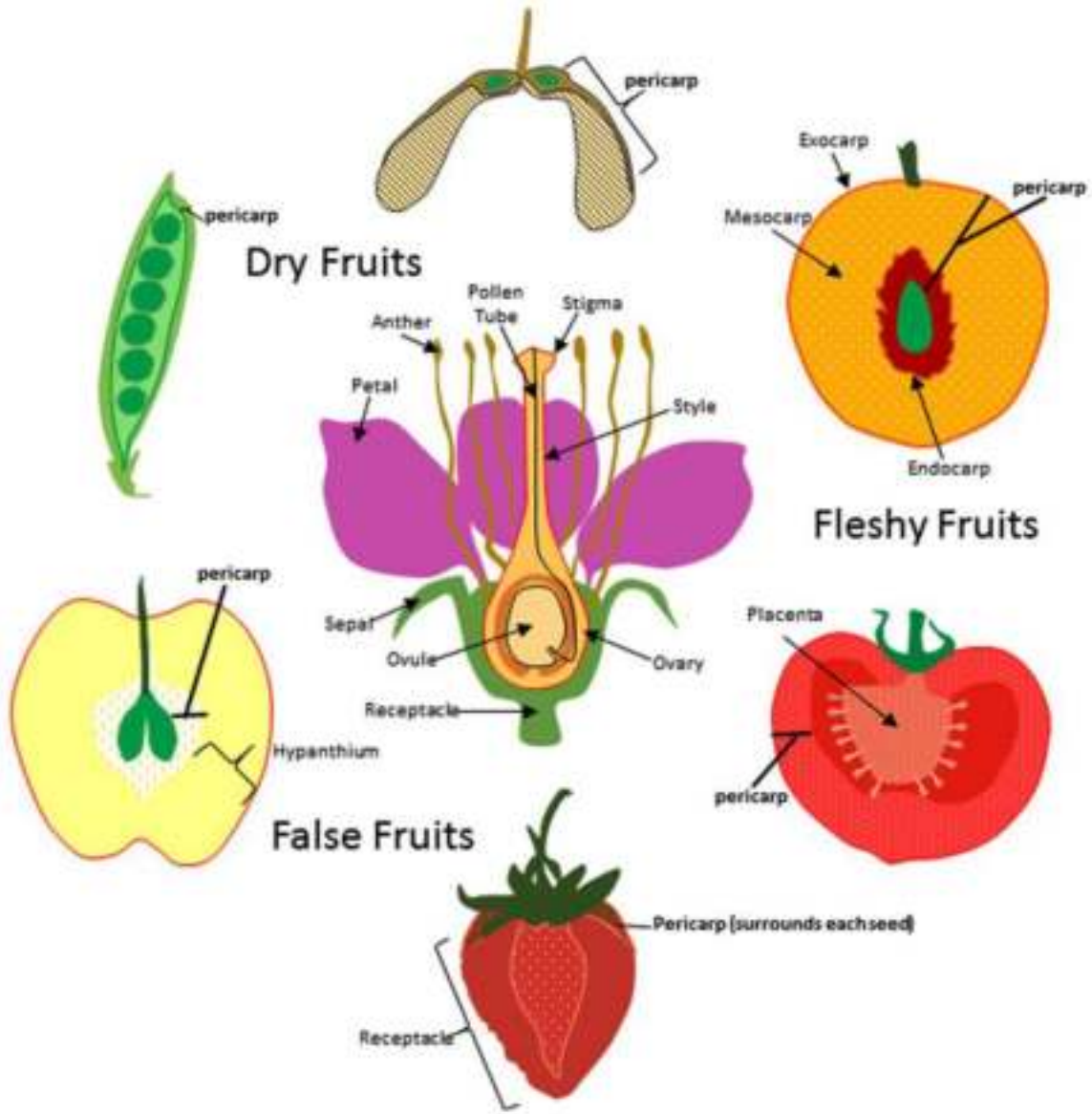
- Continue with disseminules—intro later we will follow up on plant diversity in more detail
- Get into our first case, one that we can discuss Friday—I will send references groups will present different view and debate?

Flowers--disseminules



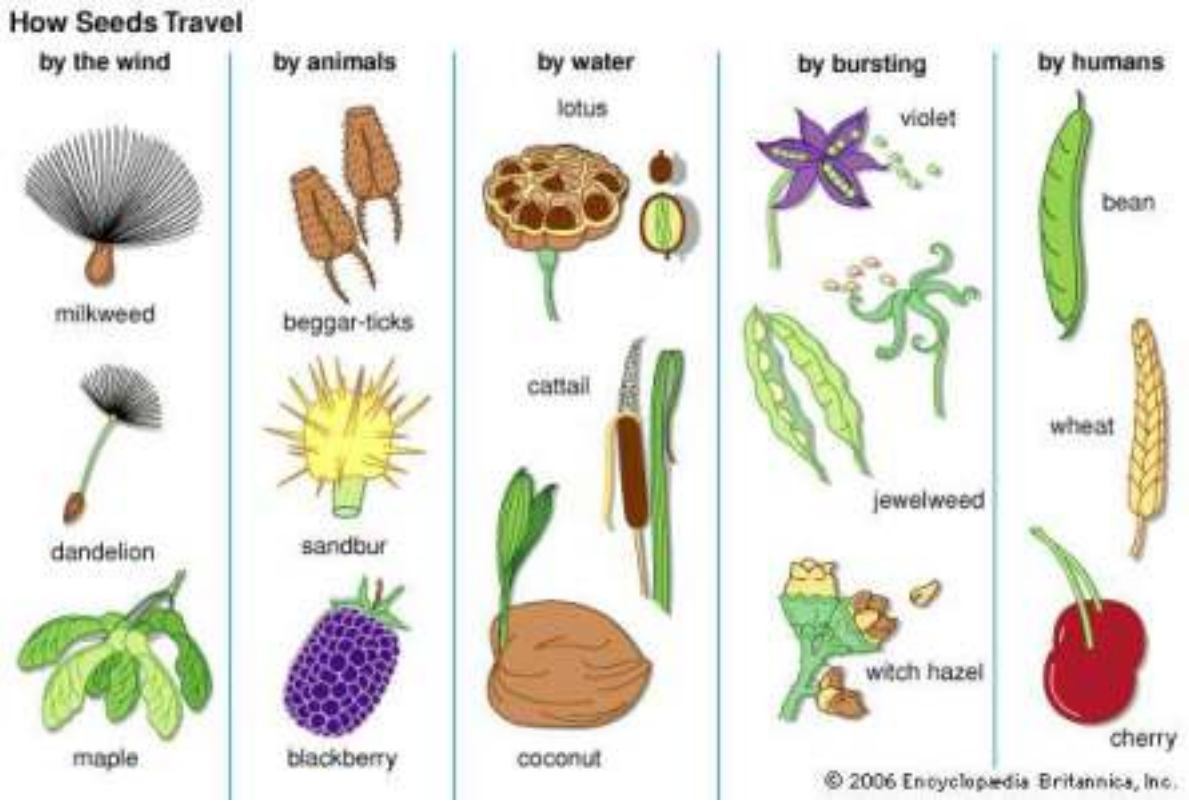
Disseminules and the life cycle flowering plants




pericarp
pericarp
Dry Fruits
Exocarp
Mesocarp
pericarp
Endocarp
Fleshy Fruits
Pollen Tube
Stigma
Anther
Petal
Style
Sepal
Ovule
Ovary
Receptacle
pericarp
Hypanthium
False Fruits
Placenta
pericarp
Pericarp (surrounds each seed)
Receptacle

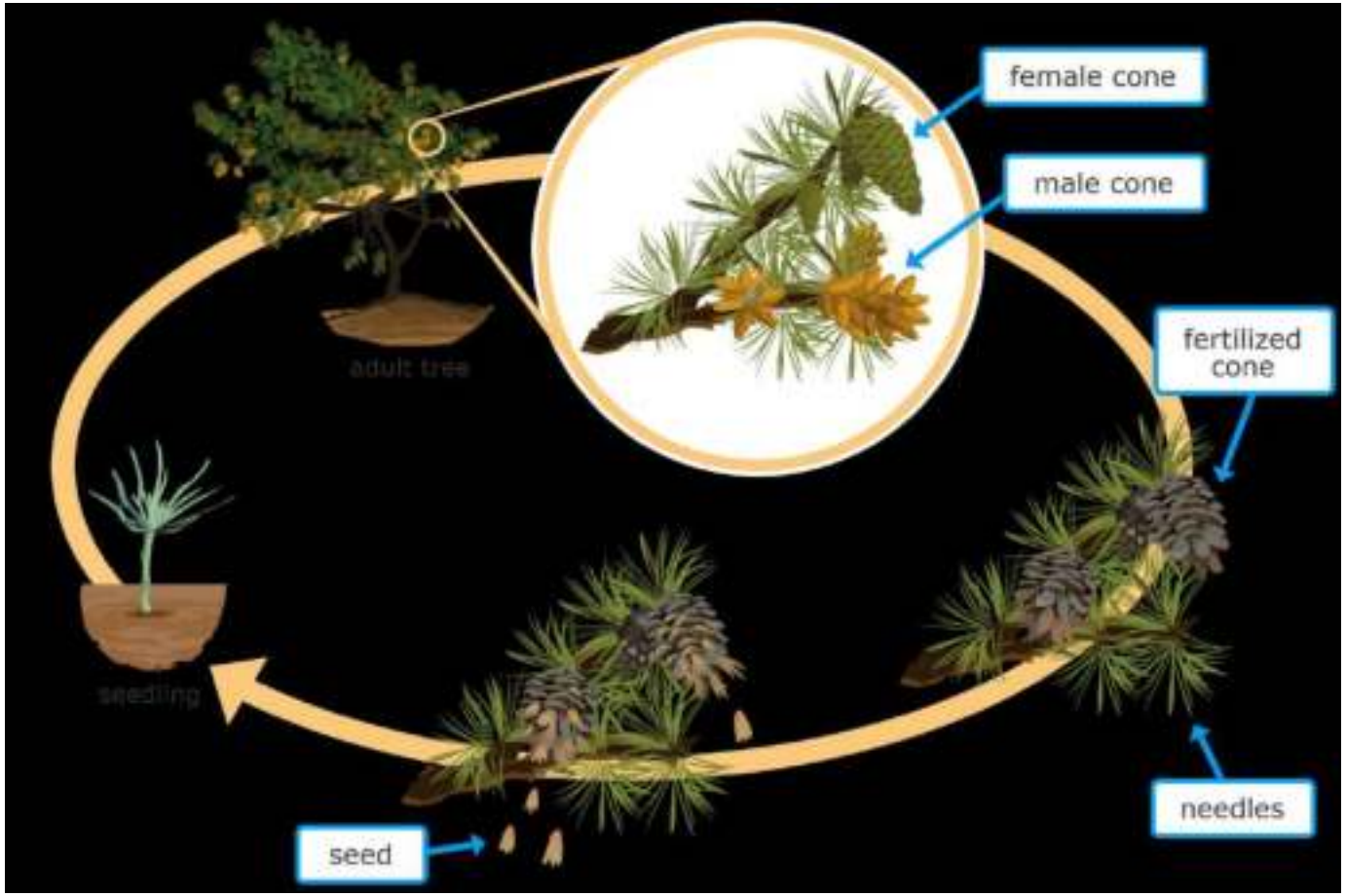

Nuts in Bladder-Like Bract
(Hophornbeam)
Acorn
(Oak)
Samara
(Maple)
Samara
(Elm)
Samara
(Ash)
Nut in Husk
(Pecan)
Multiple Seed
(Mulberry)
Multiple Seed
(Sycamore)
Pod
(Redbud)
Berry
(Texas Persimmon)
Drupe
(Hackberry)
Drupe
(Cherry)
Seeds in Prickly Bur
(Ohio Buckeye)
Cone
(Baldcypress)
Cone (Pine)
Winged Seed
Hairy Seed
(Willow)
Seeds in Spiny Bur
(Sweetgum)
Nut-Like
Drupe
(Basswood)

Seeds as dispersal units

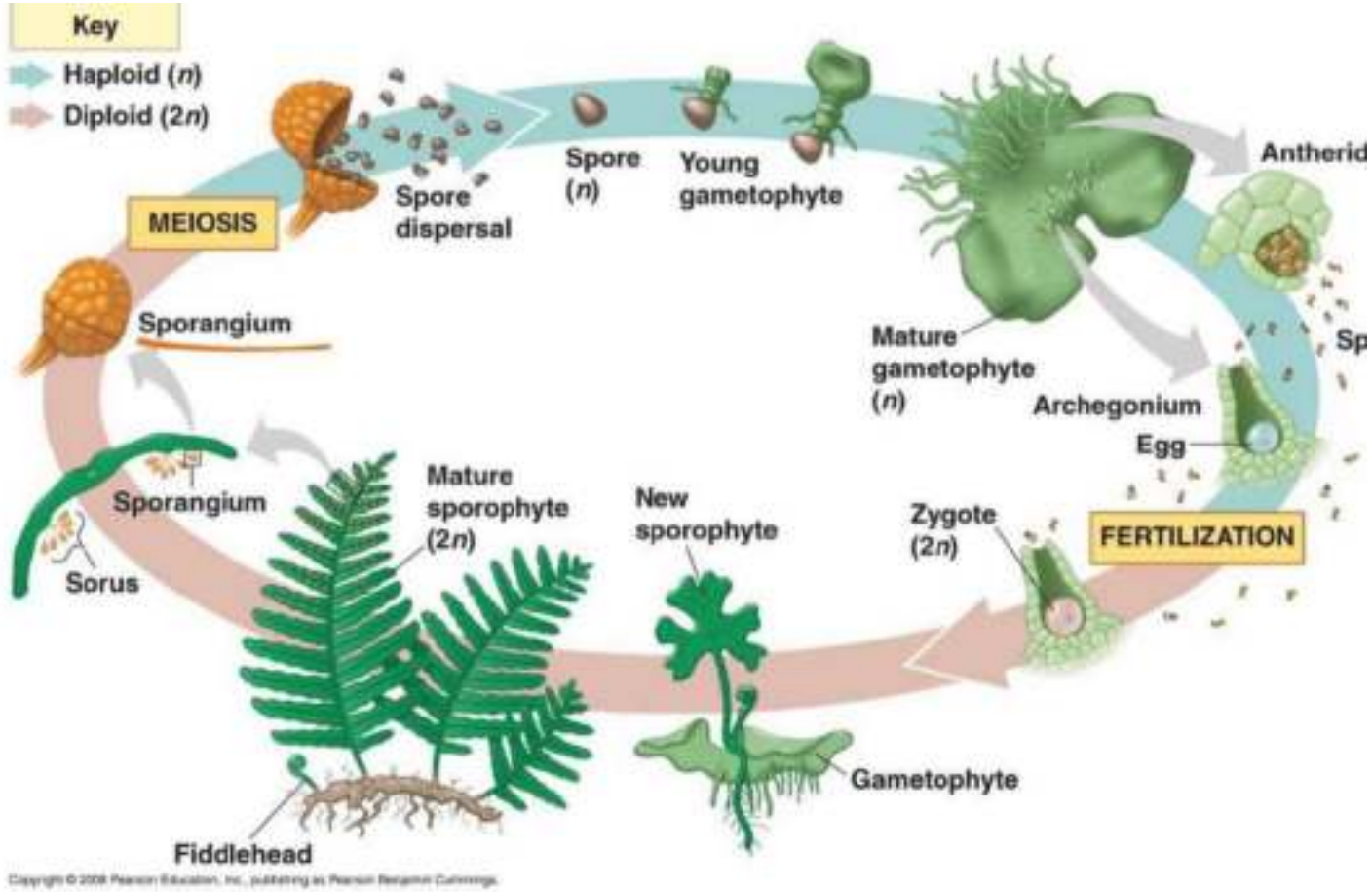


Pollen

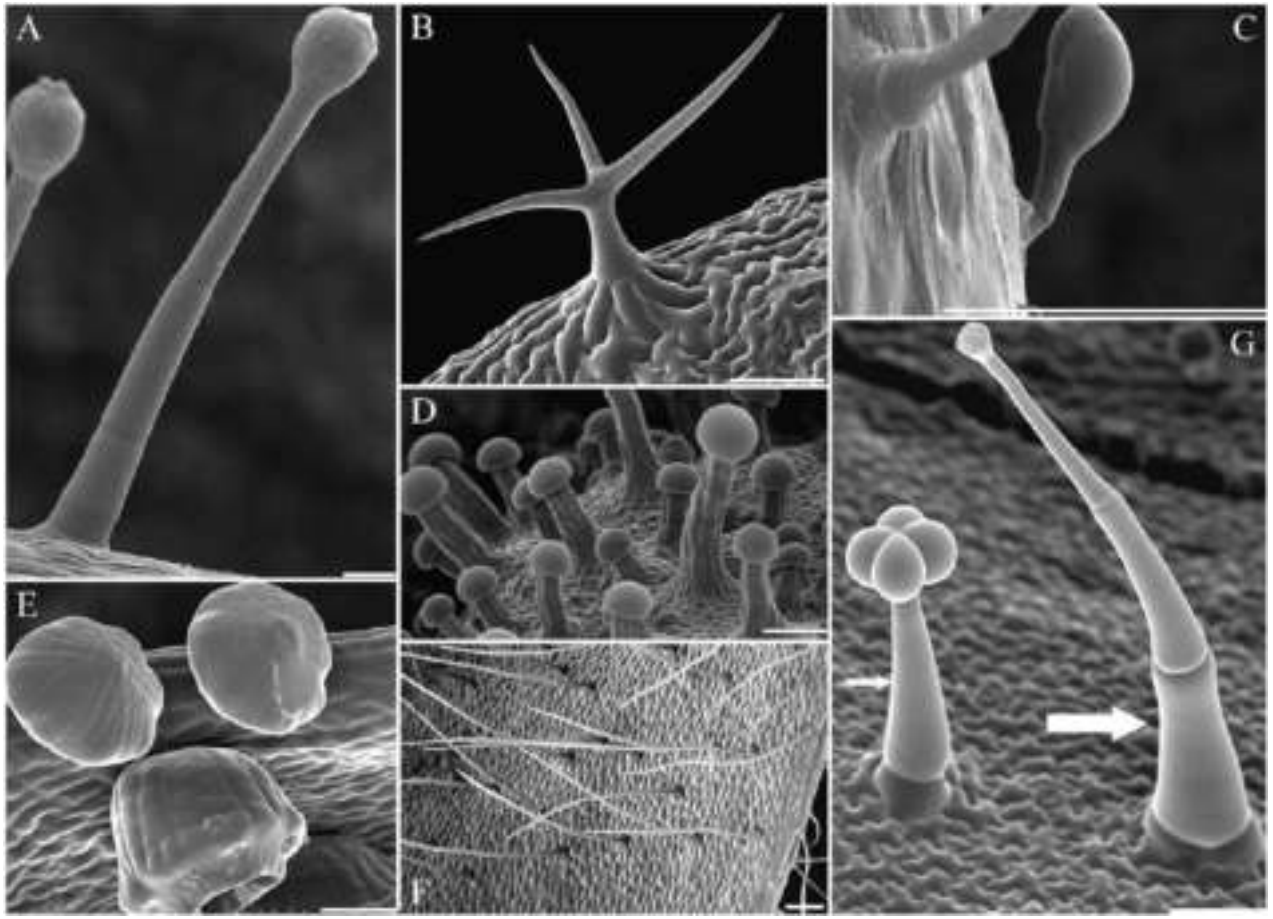
Disseminules--Conifers



Disseminules in Ferns



Disseminules-Trichomes



Not all plant forensic evidence is in disseminules as you know—e.g. USDA Forest Products Laboratory

“Wood can be found at crime scenes in many forms: as a murder weapon, as material used to hide a body, or as trace evidence from forced entry or vandalism. “

Proper collection, documentation, and storage

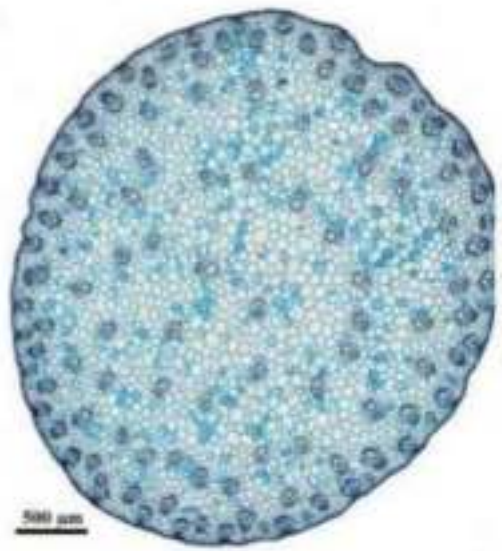
of wood evidence from a crime scene

Written by Alex C. Wiedenhoeft, Botanist

PLANTS

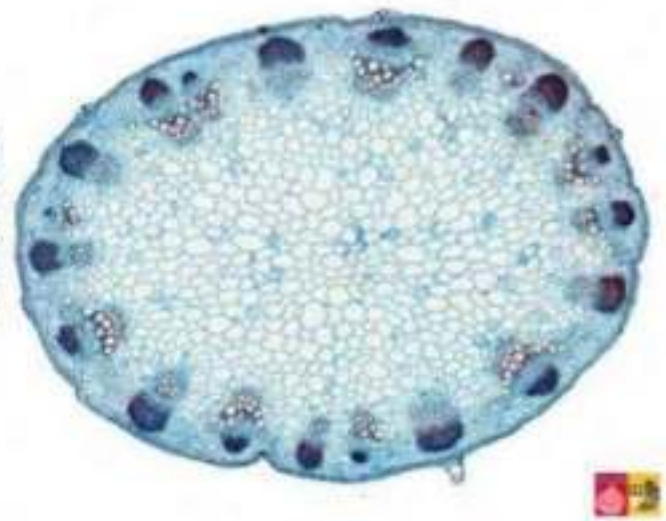
Monocots vs. dicots

Monocot stem

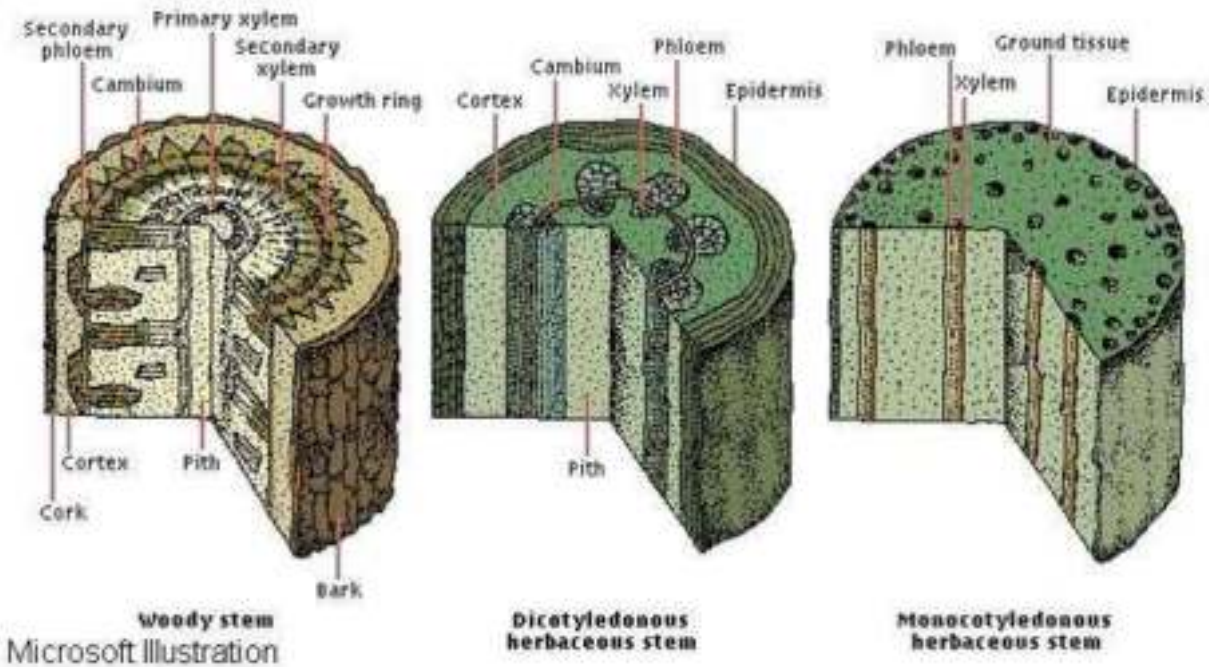


Primary vascular bundles scattered

Dicot stem



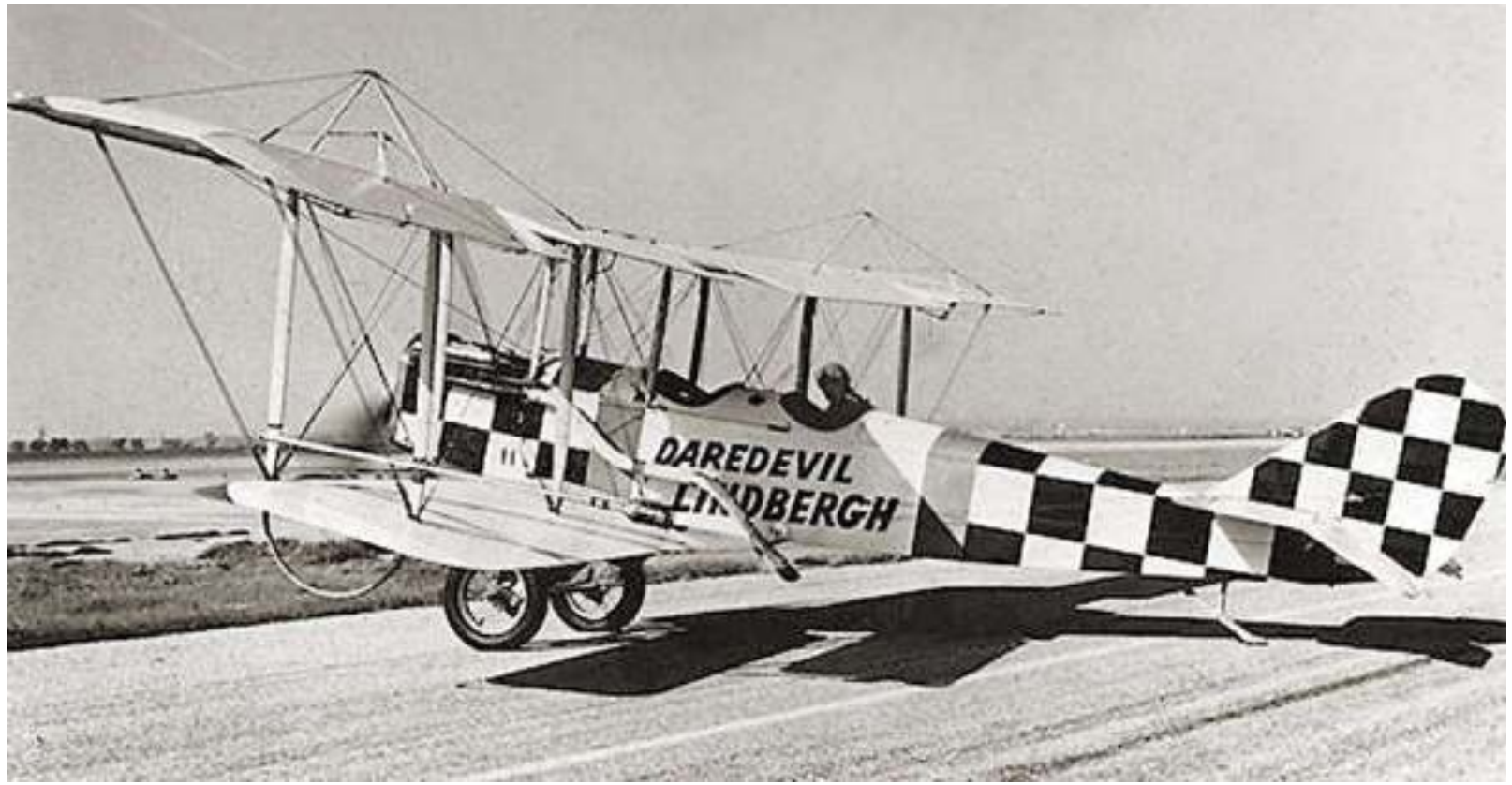
Primary vascular bundles in a ring



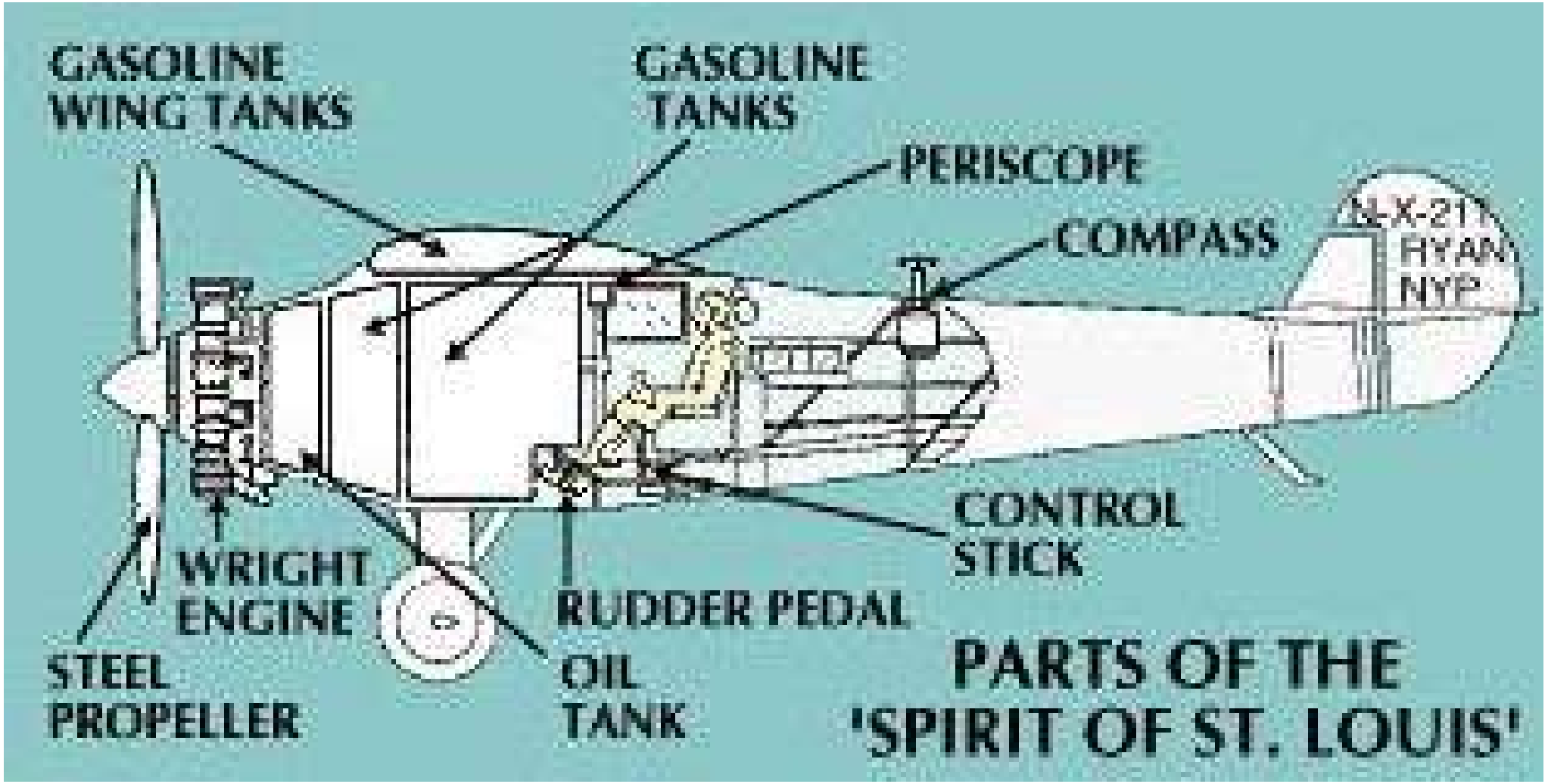
Microsoft Illustration

Let’s look at the first modern day Forensic Botany Case

Charles A. Lindbergh


DAREDEVIL

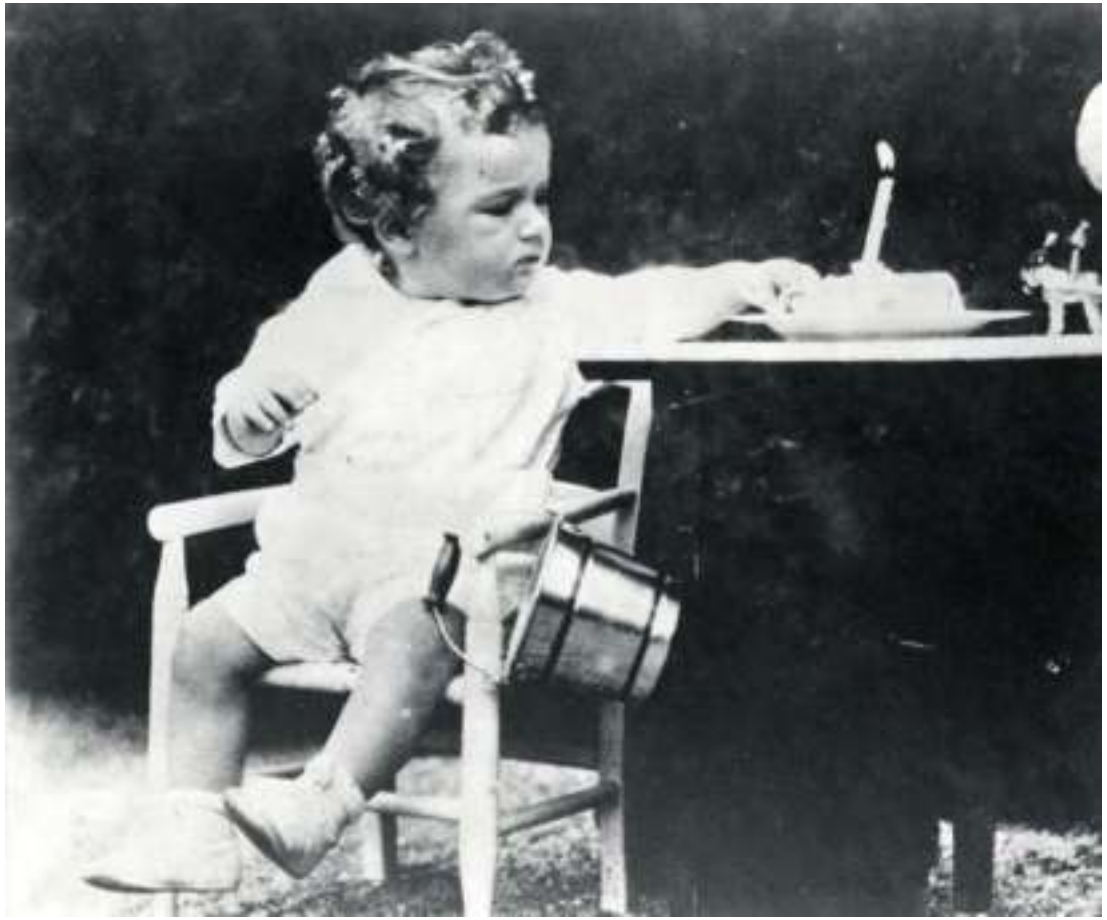

N-X-211
RYAN
Spirit of
St.Louis


GASOLINE
WING TANKS
GASOLINE
TANKS
PERISCOPE
COMPASS
X-21
RYAN
NYP
CONTROL
STICK
WRIGHT
ENGINE
RUDDER PEDAL
STEEL
PROPELLER
OIL
TANK
PARTS OF THE
'SPIRIT OF ST. LOUIS'

May 21 1927 First Transatlantic Flight: 33 Hours, 30 Minutes, 29.8 seconds


"WE"
BANQUET
in honor of
CAPTAIN CHARLES A. LINDBERGH
"AMERICA'S AIR AMBASSADOR"
NEW YORK & PARIS NON-STOP FLIGHT
Given by
The Mayor's Committee on Receptions
of the City of New York
TUESDAY, JUNE 14TH, 1927
HOTEL COMMODORE
NEW YORK
1664

Lindbergh residence, Hopewell NJ



Lindbergh residence, Hopewell- kidnap ladder alongside nursery window

Dear Sir!

Have 50.000 $ redy 25 000 $ in 20 $ bills 15000 $ in 10 $ bills and 10000 $ in 5 $ bills After 2-4 days we will inform you were to deliver the mony.

We warn you for making anyding public or for notify the Police the child is in gut care.

Indication for all letters are singnature

and 3 holds.

WANTED

INFORMATION AS TO THE WHEREABOUTS OF

CHAS. A. LINDBERGH, JR.

OF HOPEWELL, N. J.

SON OF COL. CHAS. A. LINDBERGH

World-Famous Aviator

This child was kidnaped from his home in Hopewell, N. J., between 8 and 10 p. m. on Tuesday, March 1, 1932.

DESCRIPTION:

Age, 20 months	Hair, blond, curly
Weight, 27 to 30 lbs.	Eyes, dark blue
Height, 29 inches	Complexion, light

Deep dimple in center of chin

Dressed in one-piece coverall night suit

ADDRESS ALL COMMUNICATIONS TO
COL. H. N. SCHWARZKOPF, TRENTON, N. J., or
COL. CHAS. A. LINDBERGH, HOPEWELL, N. J.

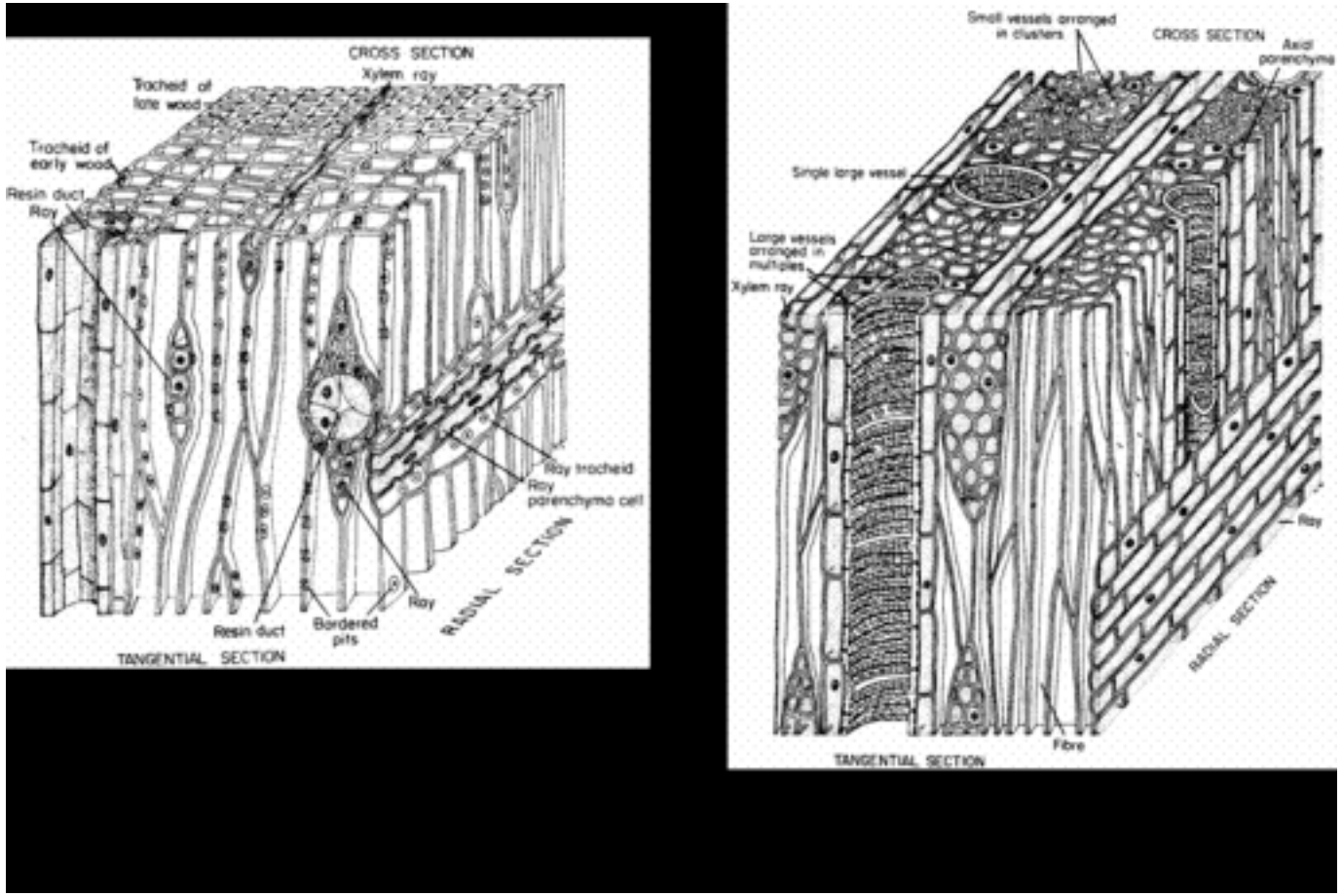
ALL COMMUNICATIONS WILL BE TREATED IN CONFIDENCE

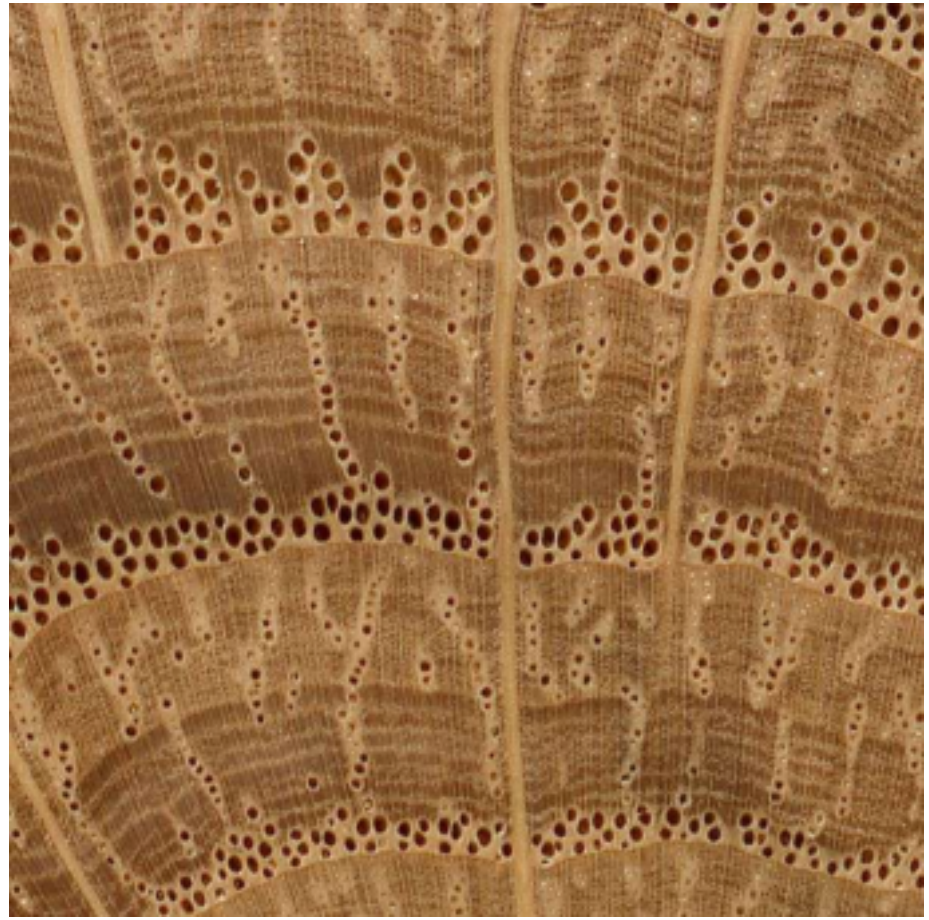
March 11, 1932

COL. H. NORMAN SCHWARZKOPF
Supt. New Jersey State Police, Trenton, N. J.


EAST TO NEW BRUNSWICK TRENTON HIGHWAY
COL. LINDBERGH AND MRS. LINDBERGH AT DINNER AT ABOUT 7.30 O'CLOCK
AT TEN-THIRTY FRANTIC NURSE REPORTS BABY'S DISAPPEARANCE TO THE FATHER AND MOTHER IN DRAWING-ROOM
BETWEEN 7.30 AND 10 O'CLOCK KIDNAPER CARRIES SLEEPING BABY DOWN LADDER WHILE WOMAN ACCOMPLICE WAITS
WEST TO LAMBERTVILLE AND THE DELAWARE RIVER.

- Arthur Koehler of the Forest Service, United States Department of Agriculture.


CROSS SECTION
Xylem ray
Tracheid of late wood
Tracheid of early wood
Resin duct
Ray
Ray tracheid
Ray parenchyma cell
RADIAL SECTION
Ray
Resin duct
Bordered pits
TANGENTIAL SECTION
Small vessels arranged in clusters
CROSS SECTION
Axial parenchyma
Single large vessel
Large vessels arranged in multiples
Xylem ray
Ray
RADIAL SECTION
Fibre
TANGENTIAL SECTION



Pinus resinosa

WOOD 280 – Macroscopic wood anatomy features

Grain

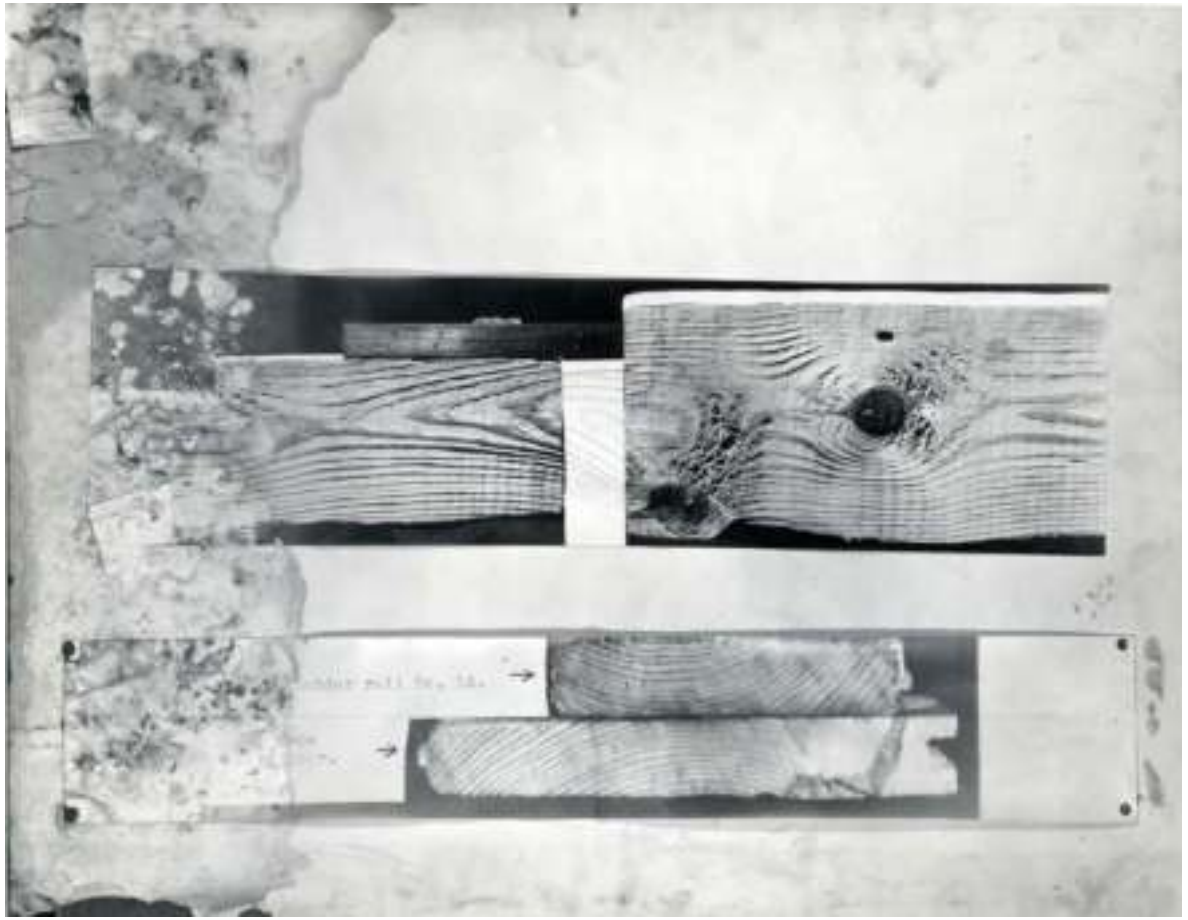
Knots

Figure

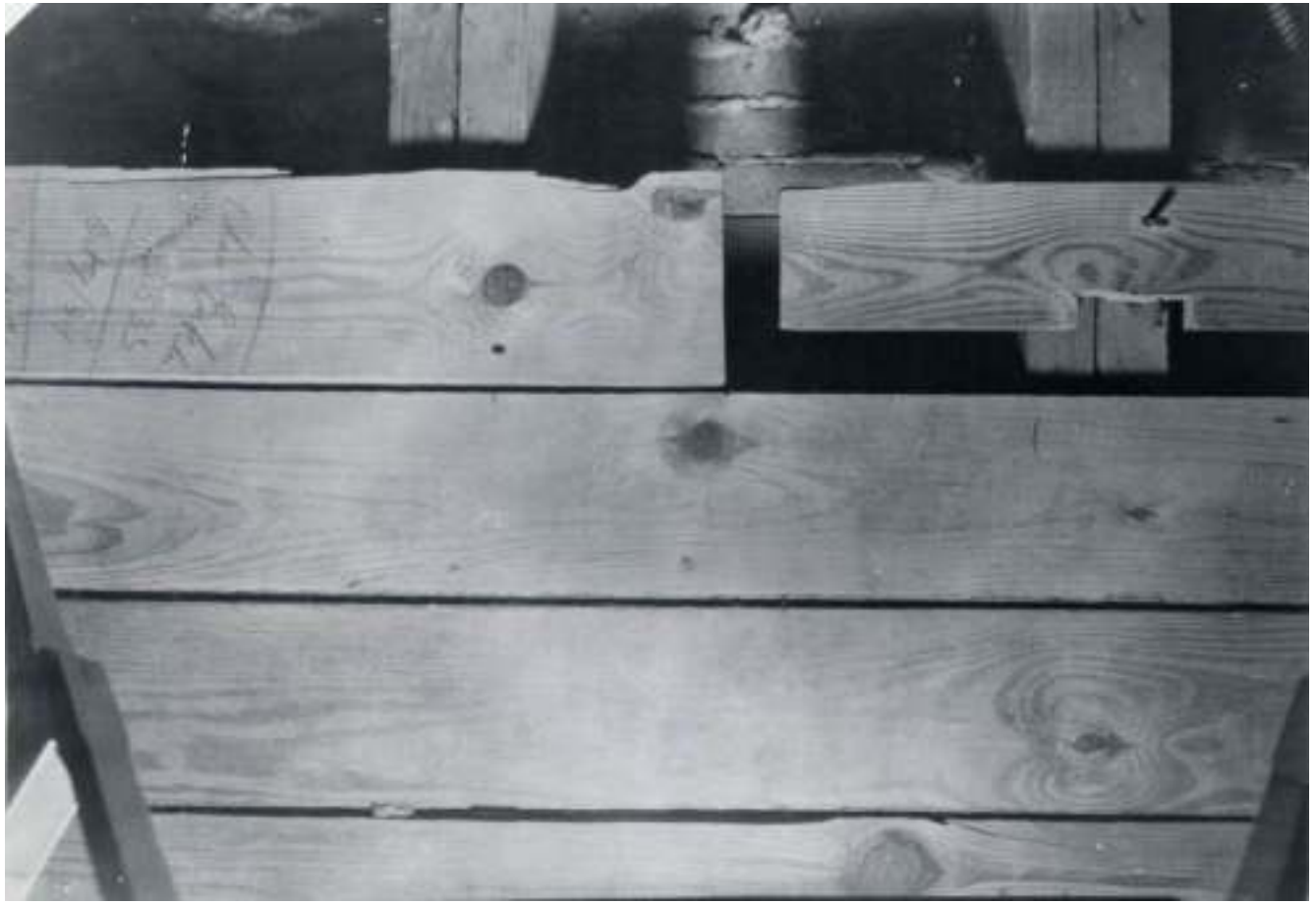
(CMSA) (Hoadley)

Lindbergh residence, Hopewell- kidnap ladder alongside nursery window

Comparison of wood grain in ladder rail #16 with attic floorboard, face and end grain



Hauptmann attic, Bronx- close up of ladder rail #16 in place on attic floor



Comparison of wood grain in ladder rail #16 with attic floorboard

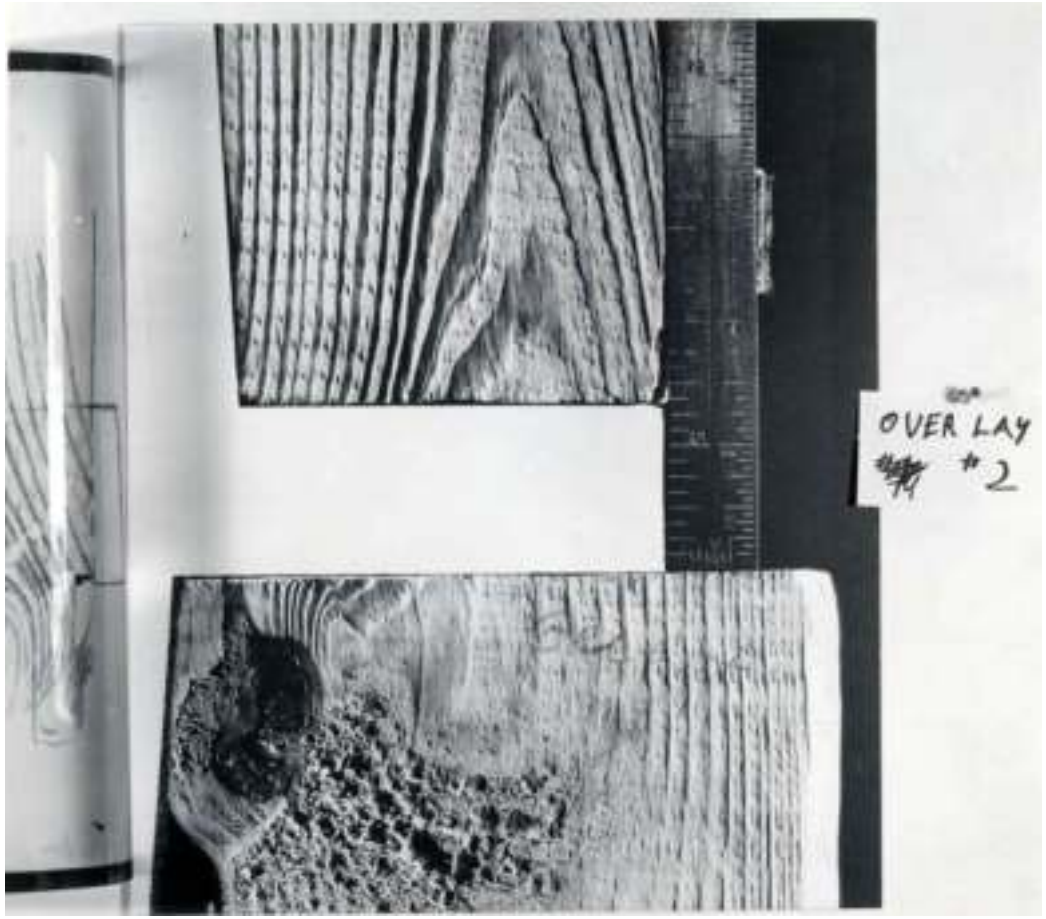
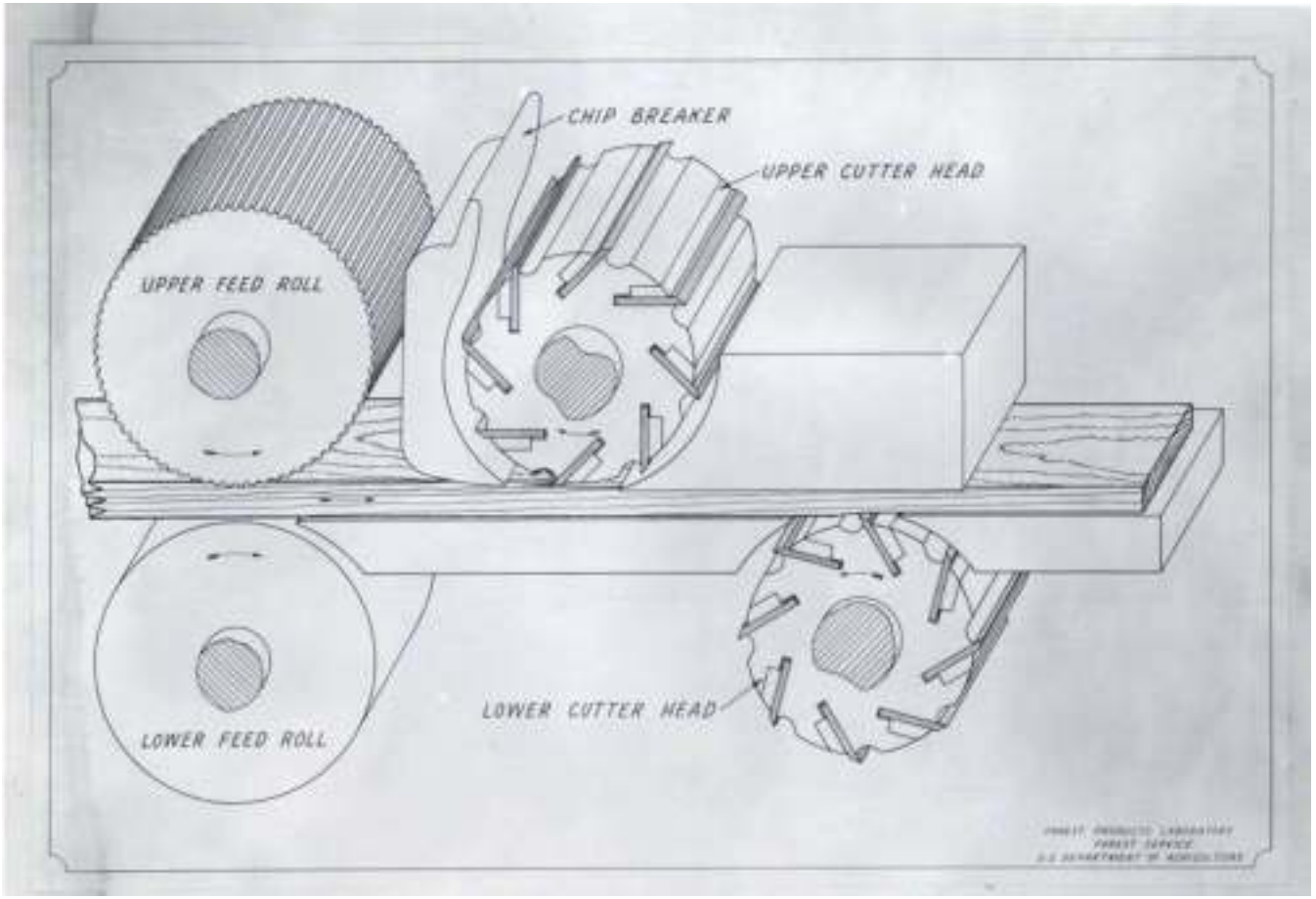
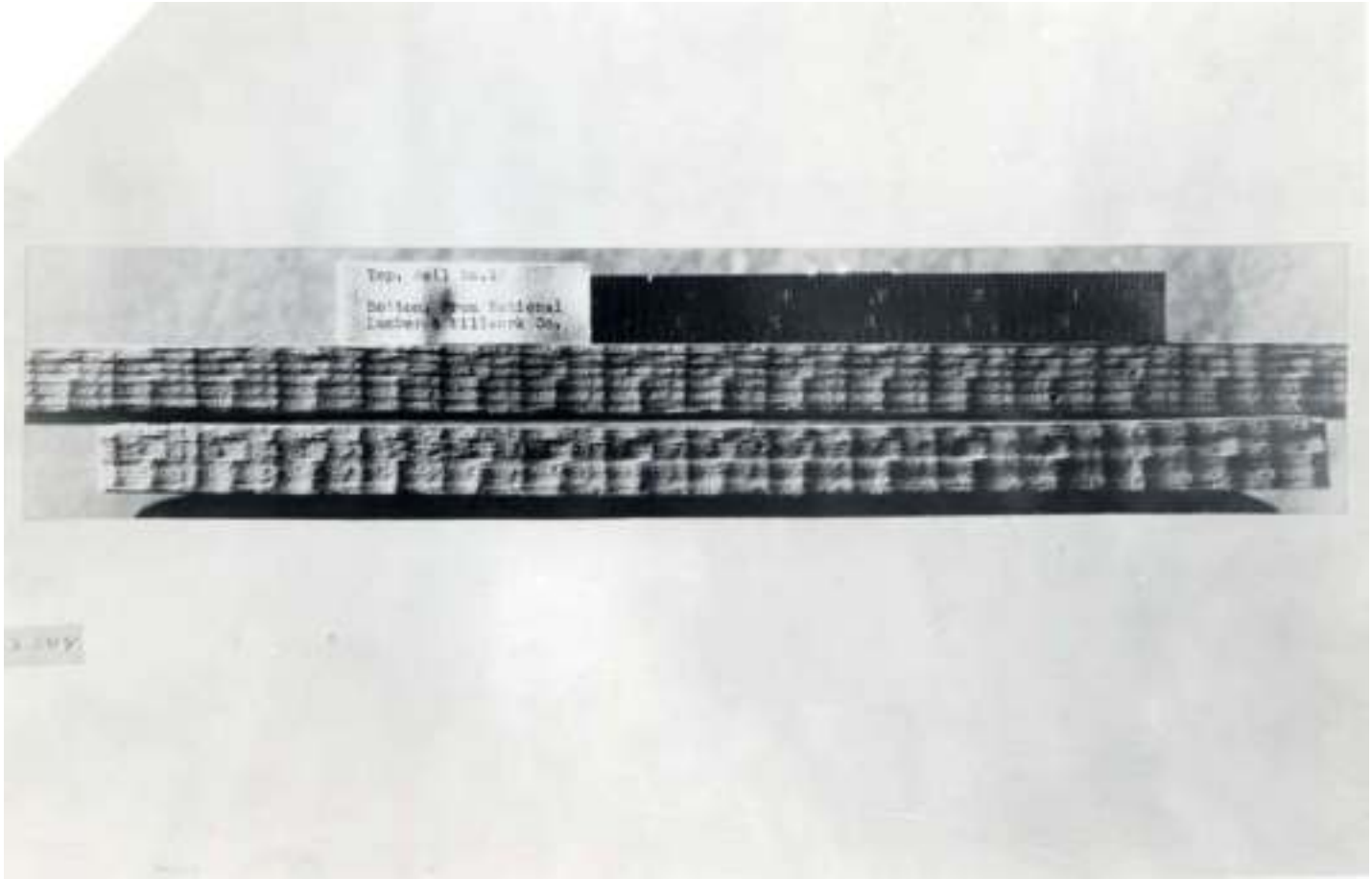
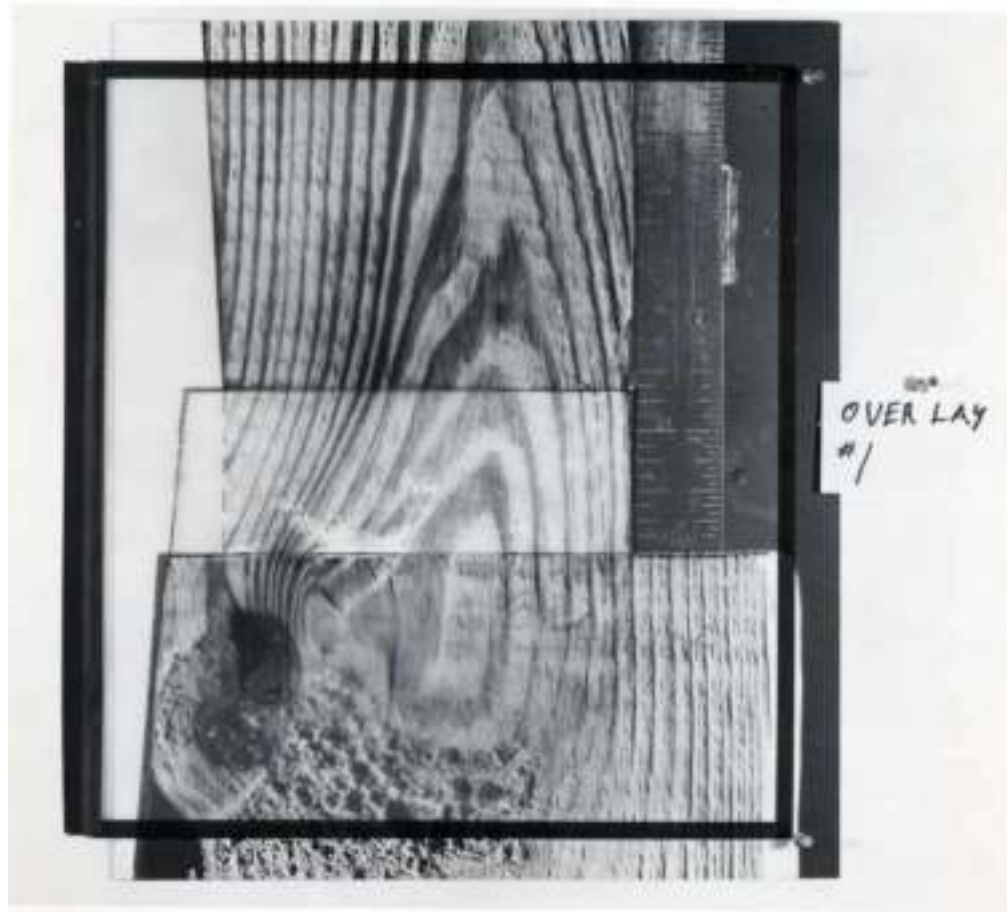


Diagram of milling machine for ladder lumber



Comparison of milling marks in ladder rail #13 with lumber from National Lumber & Millwork Co., New




OVER LAY
#1

- Koehler microscopically examined portions of the ladder and discovered marks that suggested that a planing machine had been used to smooth the side rails. He discovered several distinctive marks on the wood that had been made by the machine. Koehler asked for planed wood samples from more than 1,500 mills across the country and discovered the same marks on wood milled by Dorn Lumber in McCormick, South Carolina. From there, he traced the wood used in the ladder to National Lumber and Mill Work Company in the Bronx, where much of the ransom money had turned up.

equence is offset by two rings. This was found to be consistent with the surf
visible on the bark side surface of S-226, at a swell near a knot at the end of t
surface of Rail 16[21] (Figure 8). Therefore the offset of the rings that is
photograph is not a discrepancy. In reality it displays consistency between t
patterns, and demonstrates that the combined ring patterns of the two boar
relationship