

TRICHOMES AND SECRETORY STRUCTURES

By

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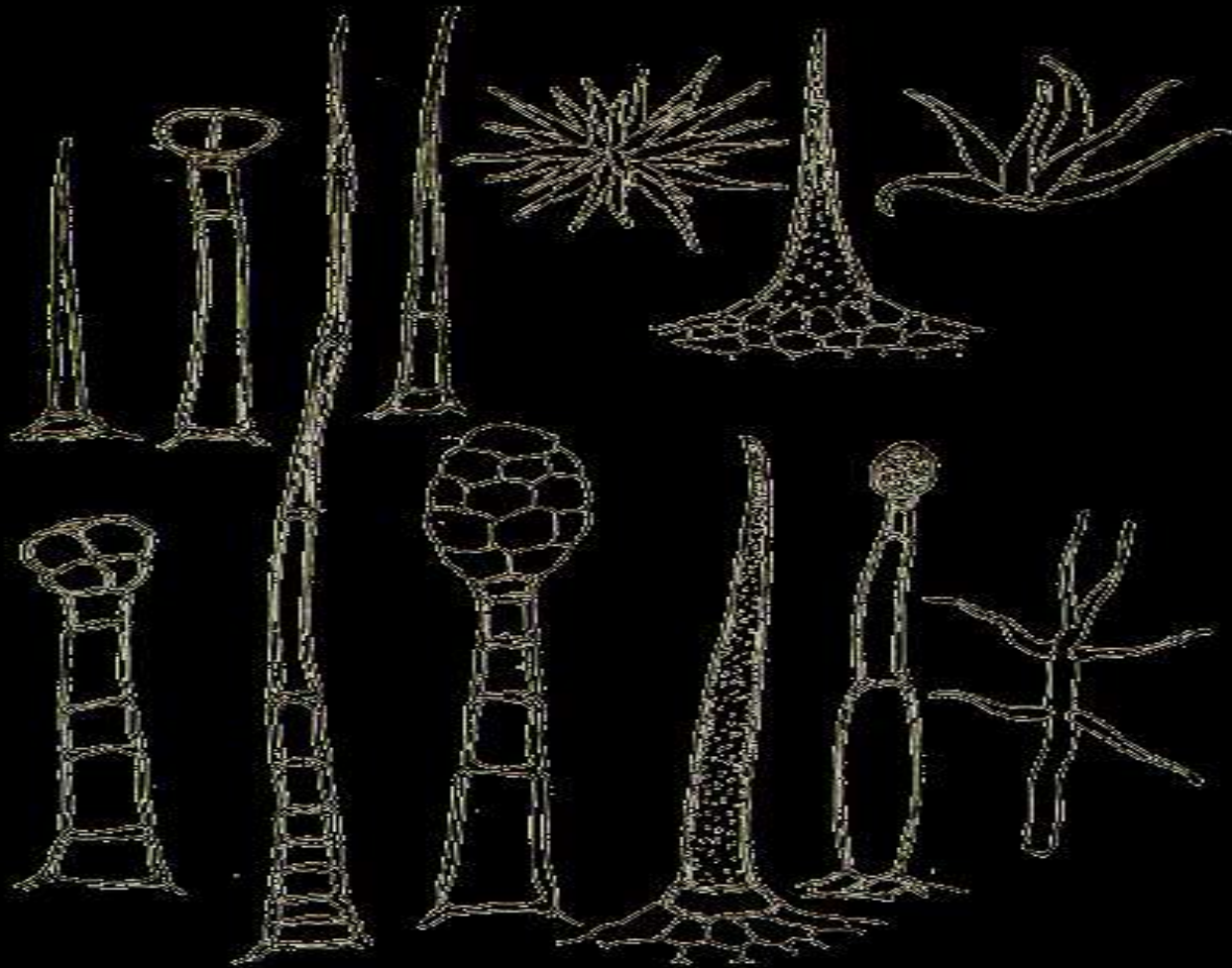
- Trichomes and secretory structures may be classified in various ways (e.g.,according to structure, type of product, position on the plant, etc.).
- Often many different kinds of non-homologous structures are included in any given category, so keep in mind that within a category, these structures may have arisen independently two to many times.

A. Trichomes

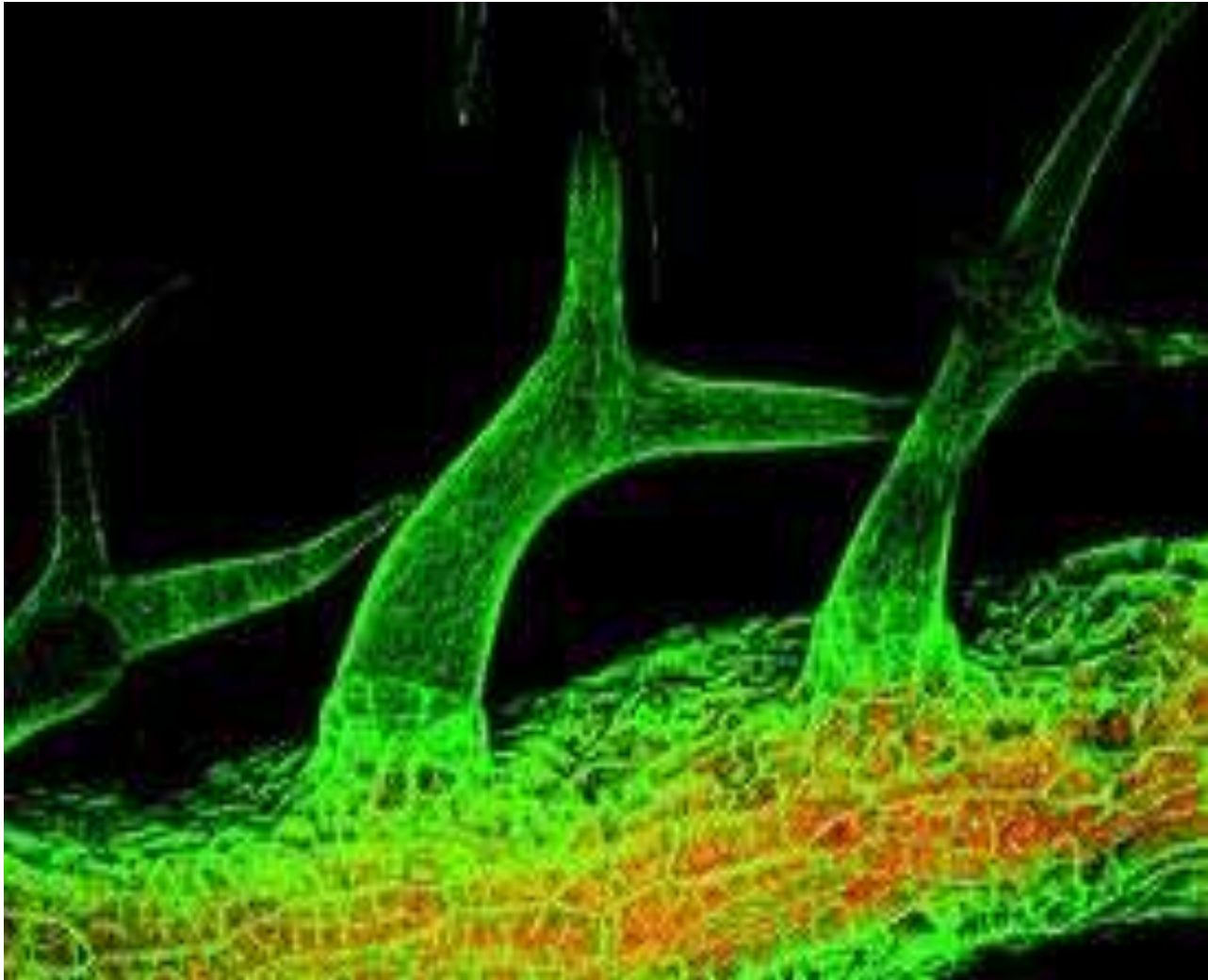
- -defined as epidermal outgrowths (e.g., hairs, scales, papillae); may be
- glandular (secretory) or not; can be taxonomically useful
- -functions various: insulation from heat or sunlight, salt removal, defense
- against herbivory, water absorption; often unclear
- -nonsecretory trichomes include

Trichome structure

A sample of trichome types:



Unicellular—aerial equivalent of a root hair, i.e., is an expanded epidermal cell; cotton fibers



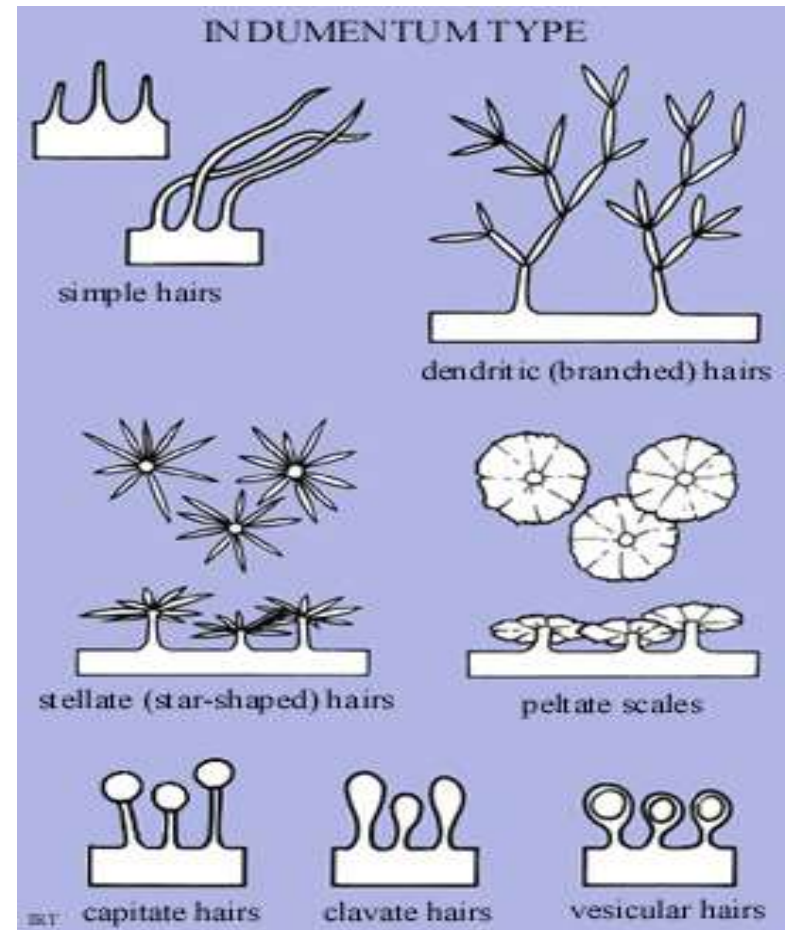
multicellular—two-celled
filamentous—uniseriate; one row of cells (e.g., coleus



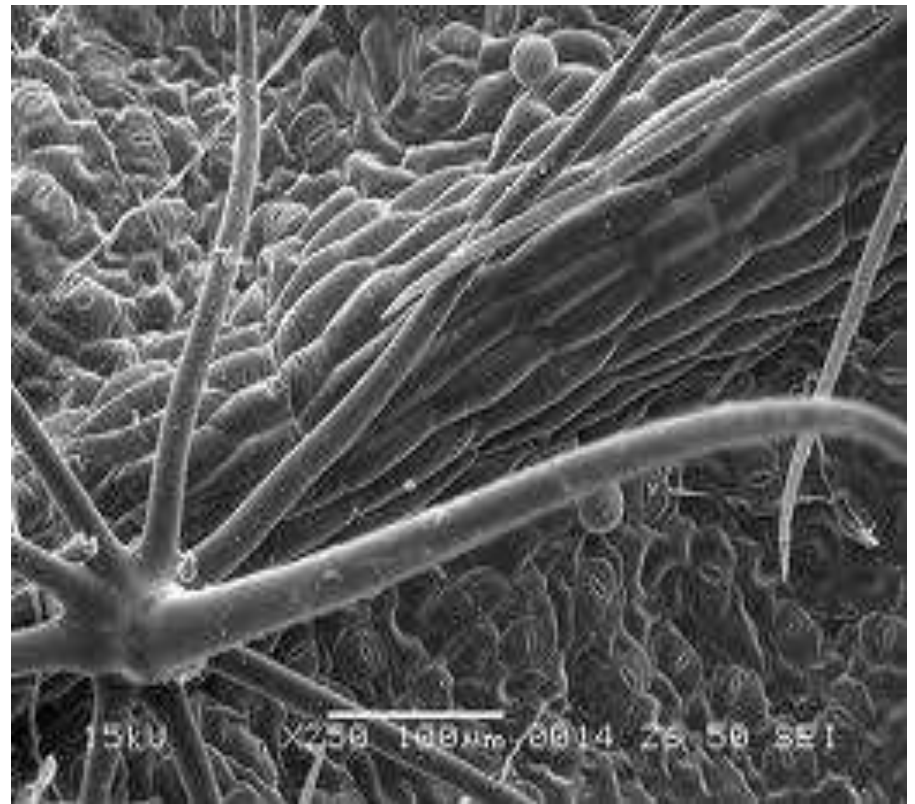
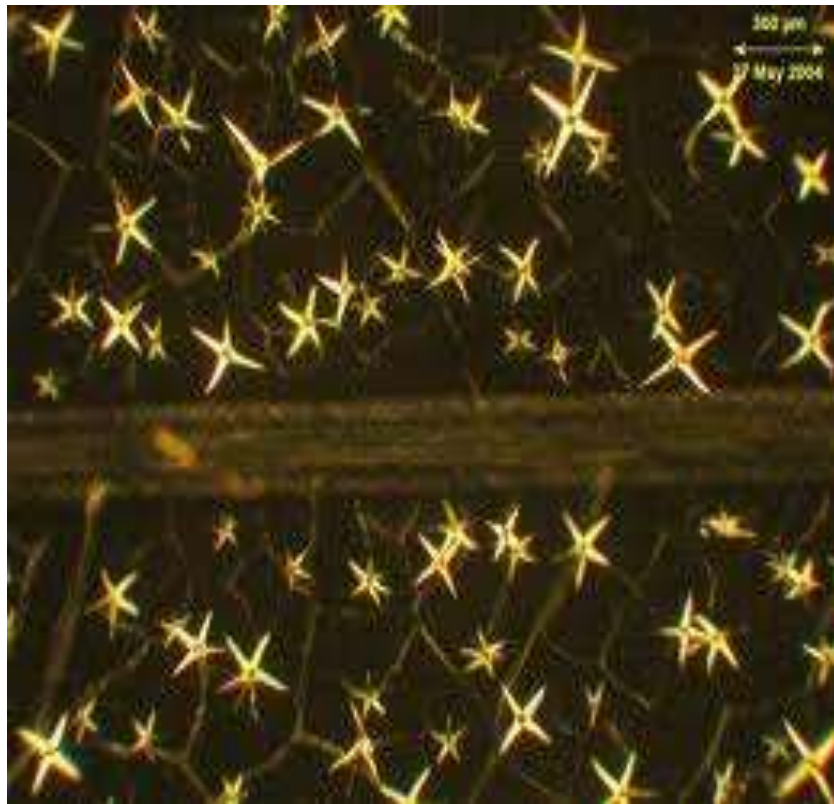
Filamentous type



Dendroid dendroid—branched filamentous (e.g., mullein)



Stellate—branches all come out from one place (e.g., oaks)



Peltate—umbrella-like; Bromeliaceae perhaps most highly developed of umbrella-like; Bromeliaceae perhaps most highly developed of peltate scales; allow capillary action; these plants are epiphytic and get water and minerals from water sucked under the scales and absorbed by basal cells of peltate trichome



B. Secretory structures

- -defined as a cell or group of cells specialized for the active release or accumulation of certain substances
- -these substances may be called secretion products
- -secretory structures vary greatly in their form and function, and there is an endless variety of secretion products
- -in one sense all cells are secretory (production of cell wall, for example)

Structures involved in external secretion

- -glandular trichomes, glands and colleterial glands all intergrade to some extent they secrete a variety of substances; the two large classes of compounds are mucilaginous and resinous, but also volatile oils
- -mucilaginous compounds soluble in water; resinous compounds soluble in organic solvents
- -epidermal cells are considered secretory in one sense because they secrete the cuticle

glandular or secretory trichomes

- -almost always multicellular and stalked (e.g., in mint family) but some are unicellular (e.g., stinging hairs of nettles—one big cell, of silica dioxide, with toxic material at bulbous base, tip needle-like, asymmetrical; acts like a hypodermic needle)
- -secretory products diverse, from mucilage to resin -essentially are outgrowths of the epidermis
- -barrier cell(s) prevent backflow of secretory product into plant in multicellular ones
- -usually secretory product remains within the cuticle until damage occurs

glandular or secretory trichomes

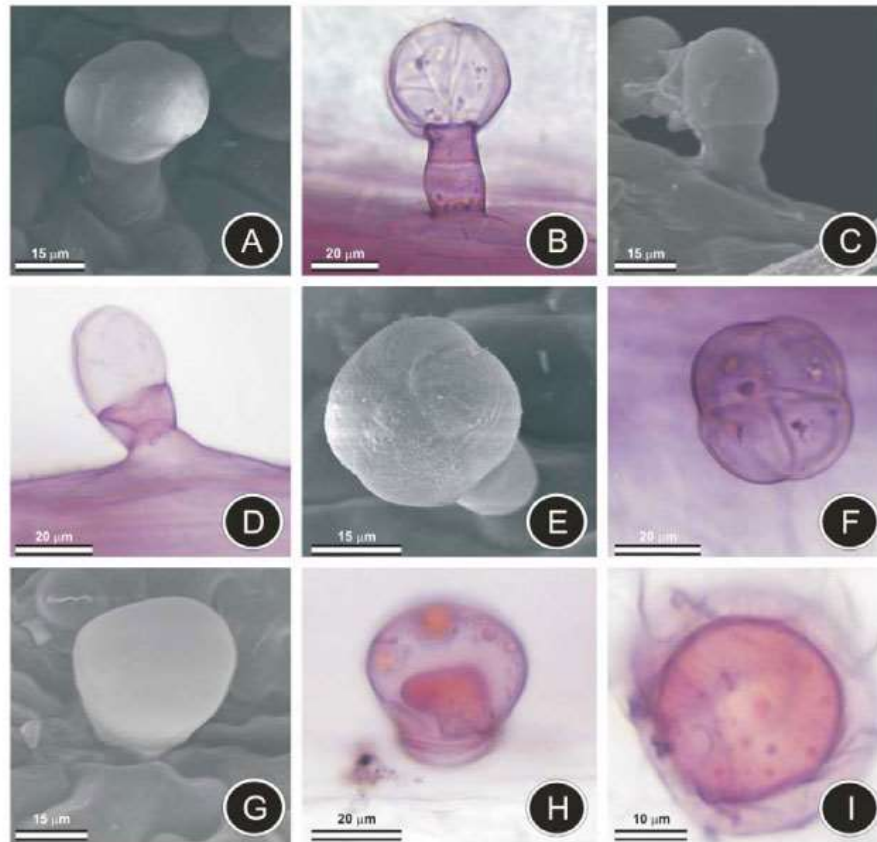


Figure 5 - Types of glandular trichomes in *Lantana radula*. A, C, E and G - Scanning electron microscopy (SEM). B, D, F, H and I - Leaf clearing. A and B - Capitate trichomes of type I with four cells in the secretory head. C, D, E and F - Capitate trichomes of type II with one or four cells in the secretory head. G, H, I - Capitate trichome of type III, unicellular.

Non-glandular trichome



Secretory trichome



b.colleters

- -special kind of trichome, stalked or sessile
- -axis of elongated cells, and an exaggerated palisade-like epidermis (secretory parenchyma)
- -function only in the bud, where they secrete a sticky substance; not in mature branches
- -common in woody plants
- -function to prevent desiccation, prevent herbivory

Marijuana **Trichomes** Marijuana Bud **Trichomes**



glands

- -larger, more embedded in the organ, not just an outgrowth of the epidermis
- -commonly occur along the margins of leaves (and other serial organs)
- -secrete a wide range of substances
- -in the gland area, epidermal cells are palisade-like, with vascular tissue right up to the gland; often glands contain tracheary elements
- -examples include salt glands, digestive glands

1. **Plant** (*Mentha piperita*), showing oil (yellow) above its oil **glands**
2. **Salt glands** on leaf surface. White **salt glands** that appear as small
3. In the Venus' fly-trap, *Dionaea muscipula*, **digestive glands**



hydathodes

- -involved in the secretion of liquid water, by a process called guttation when ground and atmosphere are saturated, and thus not much transpiration, plant can excrete water and thus relieve excess pressure through hydathodes but main function may be to redistribute minerals and other nutrients.
- -three types of hydathodes: hydathode trichomes, active hydathodes, and passive hydathodes
- i. hydathode trichome—water forced out the tip by metabolic activity

- ii. active hydathode—vein ending, with tightly packed epithem cells (chloroplast-free, more or less modified mesophyll cells) surrounded by a sheath (often with casparian strips) and one or more water pores (stomates that are usually permanently open); water passes through epithem cells and minerals may be reabsorbed (mediated by transfer cells) before water is forced out through the pore(s); essentially a modified leaf toothiii.
- passive hydathode—similar to colletes but epithem cells are loosely arranged and water flows between them water pores of hydathodes always sunken

Pictures of Hydathode



Guttating strawberry leaf.

Nectaries

- -may be glandular or hydathode-like; unicellular or multicellular -main product is a sugar solution (nectar); conspicuous phloem and little or no xylem associated with nectaries
- -can be floral (inside the flower) or extrafloral (outside the flower)
- -floral nectaries attract pollinators; extrafloral nectaries most common on
- leaves, attract ants, which help to protect the plant

2. Structures involved in internal secretion

can also be thought of as structures that accumulate materials

- a. accumulation spaces -traditionally thought to form in two basic ways: schizogeny and lysigeny (or a combination—schizolysigeny)
- -schizogenous spaces form by enlargement of an intercellular space (separation of cells or layers of cells); secretion product produced by glandular cells (epithelium) lining the space (these cells remain alive)
- -lysigenous spaces form by breakdown of cells (autolysis) that release
secretion products as they degenerate
- but, there are many conflicting reports of schizogeny and lysigeny for the same species in the literature and evidence indicates that what appears to be lysigeny may actually be artifacts due to poor or inadequate fixation; therefore, lysigeny may be a false category of secretory structure development

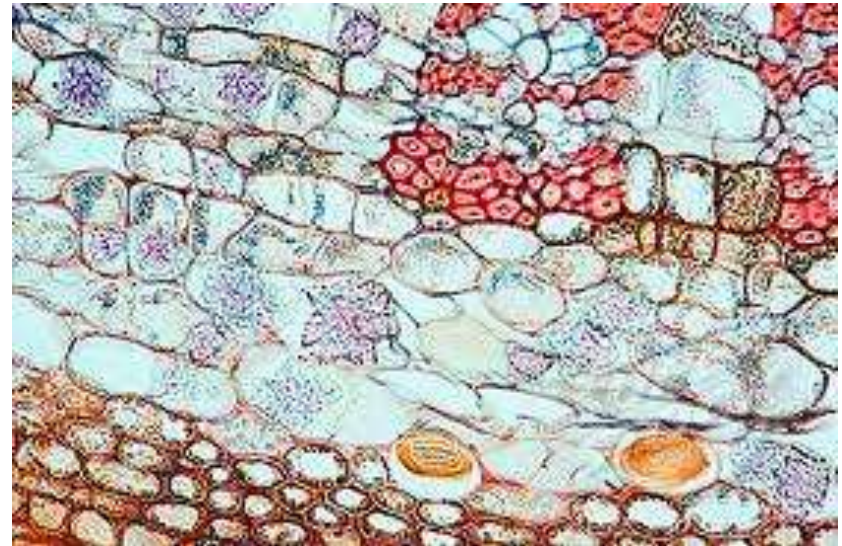
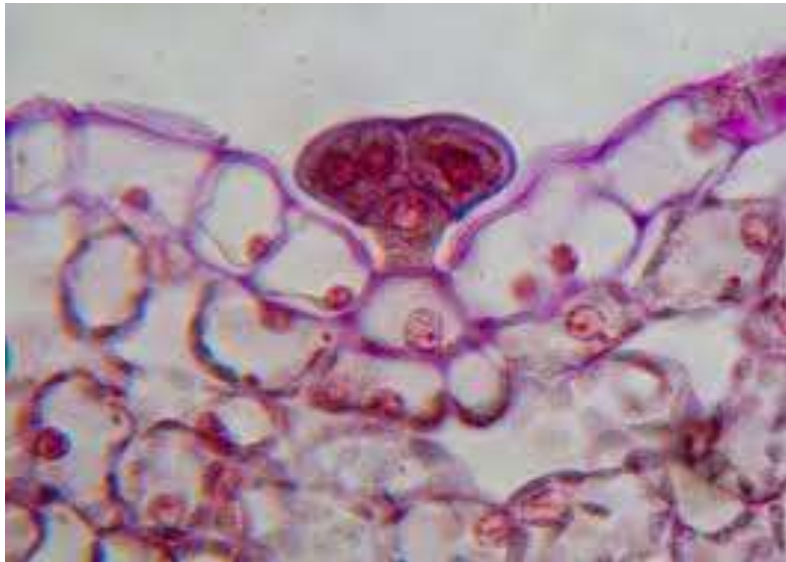
plants attract ants with nectaries



b. idioblasts

- (single cells involved in secretion/accumulation)
- -include tanniniferous cells, pigmented cells, crystalliferous cells, lithocysts,
- myrosin cells, mucilaginous cells, and silica cells

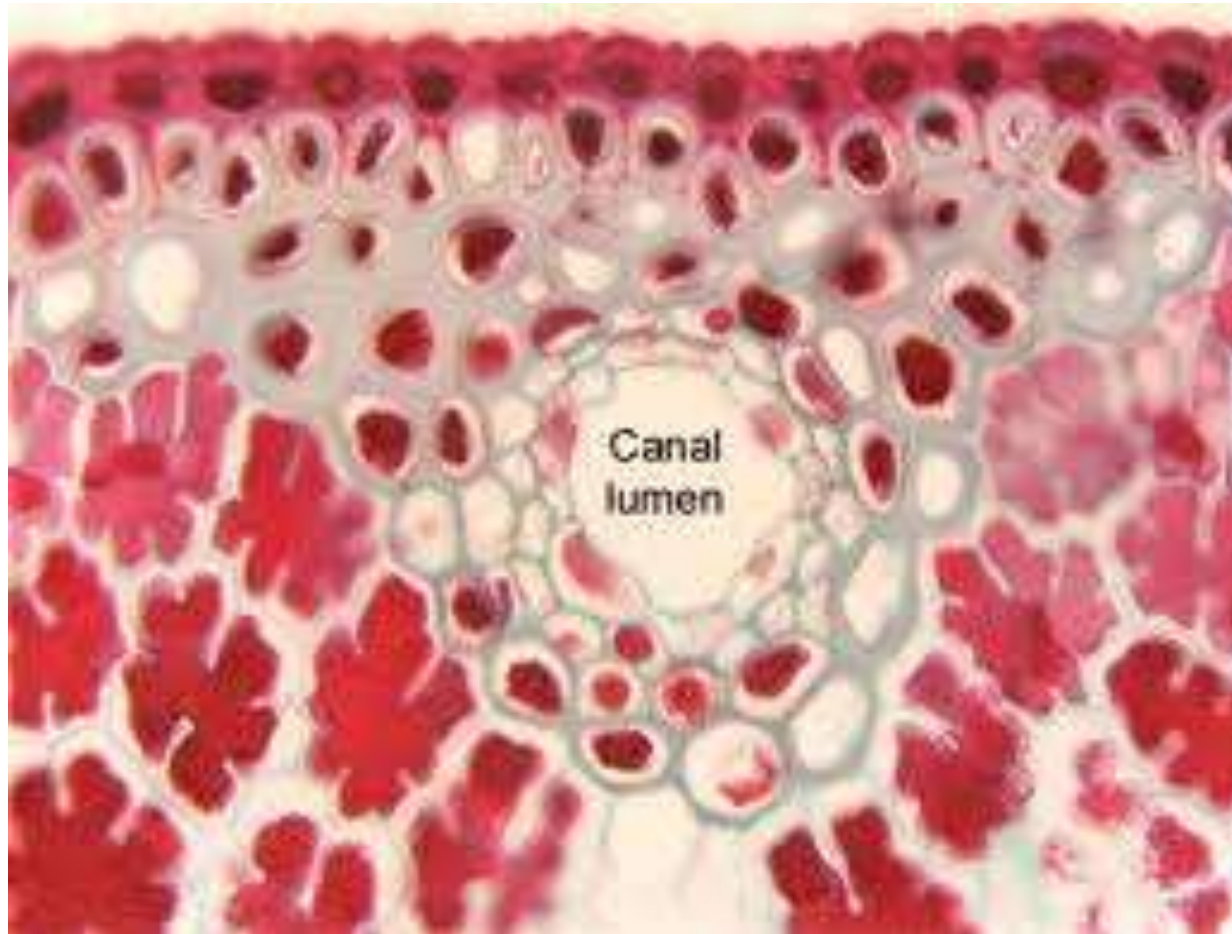
tissue systems of **plants** can contain
idioblasts



c. cavities and canals/ducts

- -lined with an epithelium (made of cells specialized for secretion or may be inactive); may have casparian strips
- -cavities are finite internal spaces
- -canals/ducts are of indefinite length, long and interconnected (elongate by recruitment of parenchyma cells)
- -accumulate mucilaginous, oily or resinous materials
- -e.g., resin canals in conifers; natural function seems to be protection from grazing or browsing animal

The needles of pines and many other conifers have resin **canals**



d. laticifers

- internal secretory structures that contain latex
- -latex is chemically complex, but an important constituent is alkaloids
- -about 20 families, mostly dicots, have laticifers (lettuce is the only edible species)
- -two types:
 - i. articulated—differentiate like a sieve tube, that is, with many cells end to end; the individual cells have modified end walls or end walls ultimately digested away (growth by recruitment of parenchyma cells); may be interconnected or not

poppy capsules, **laticifers**



THANK YOU...