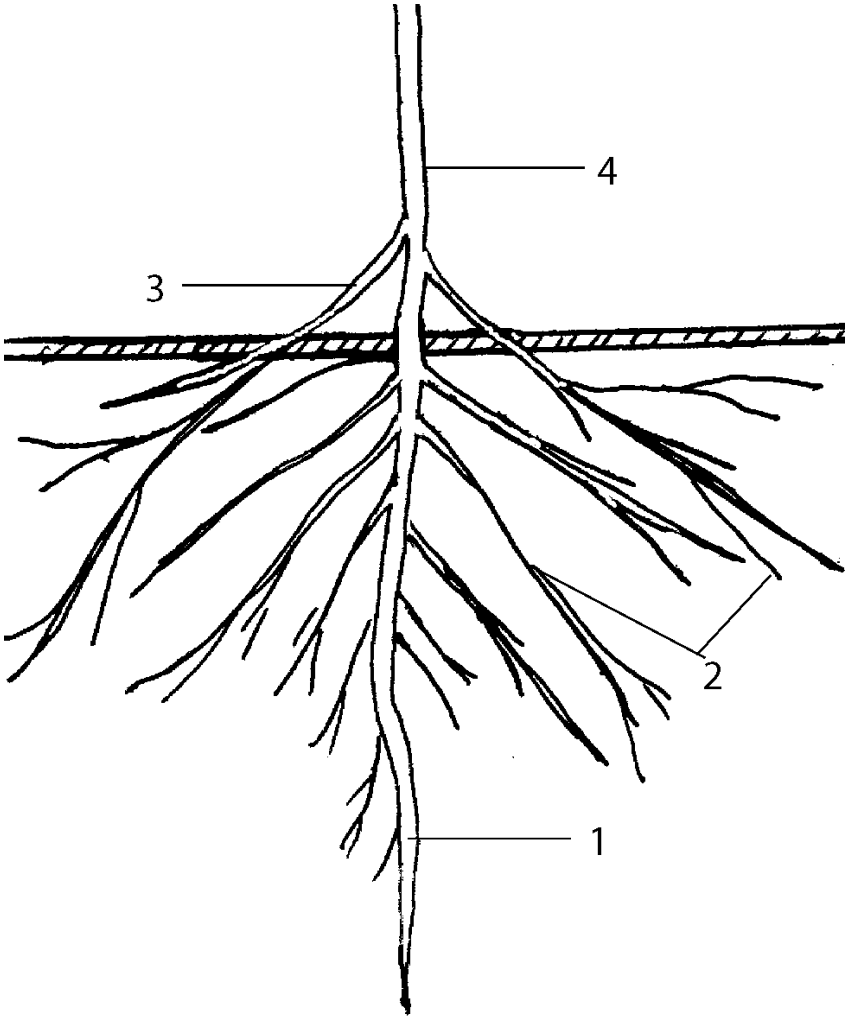
Thematic block: Vegetative organs of plants.

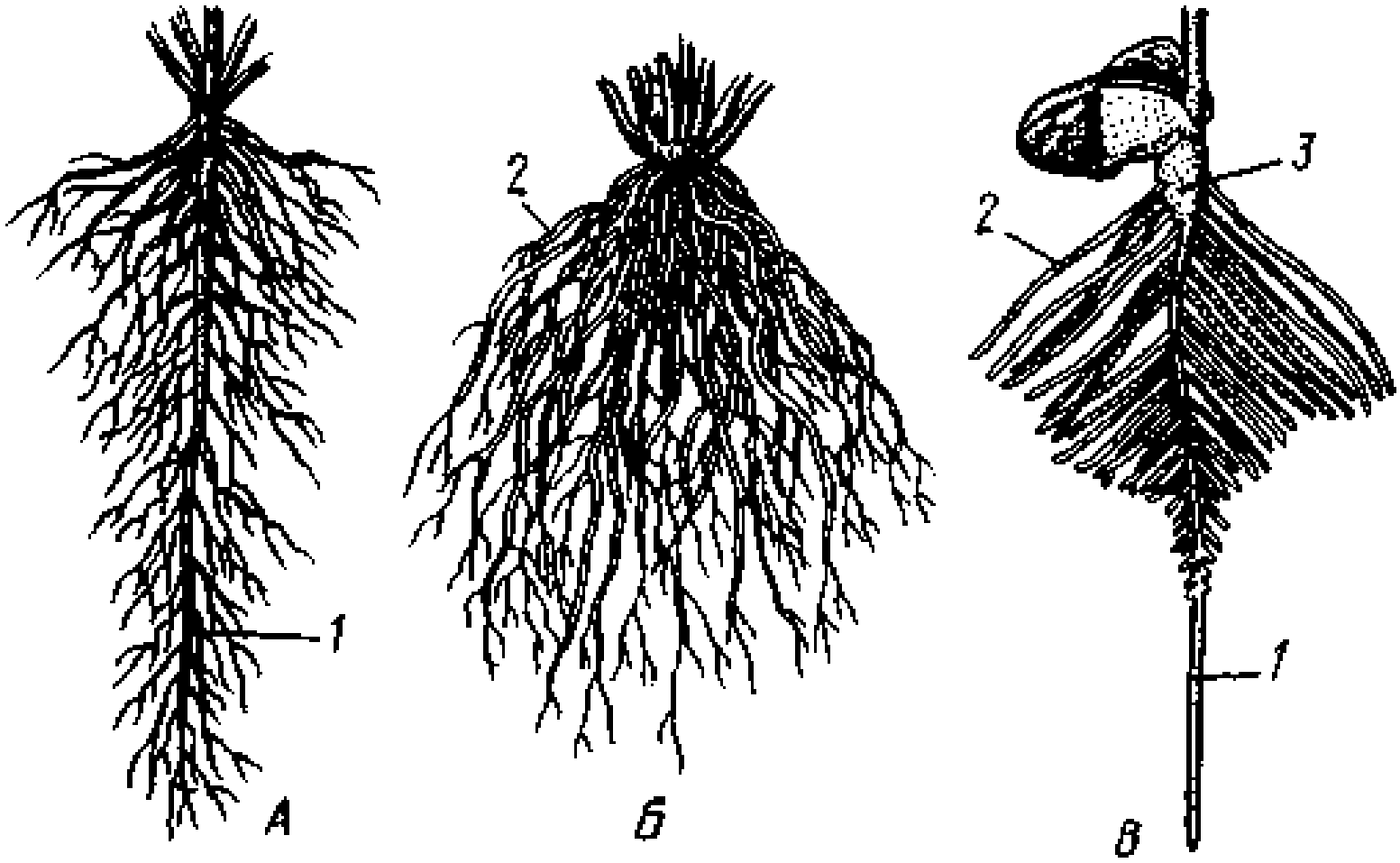
Lesson 3.1. The structure of the root



1 – the tap root, 2 – the lateral root, 3 – the adventitious root, 4 – the stems.


Corn root
Adventitious root
Orchid root

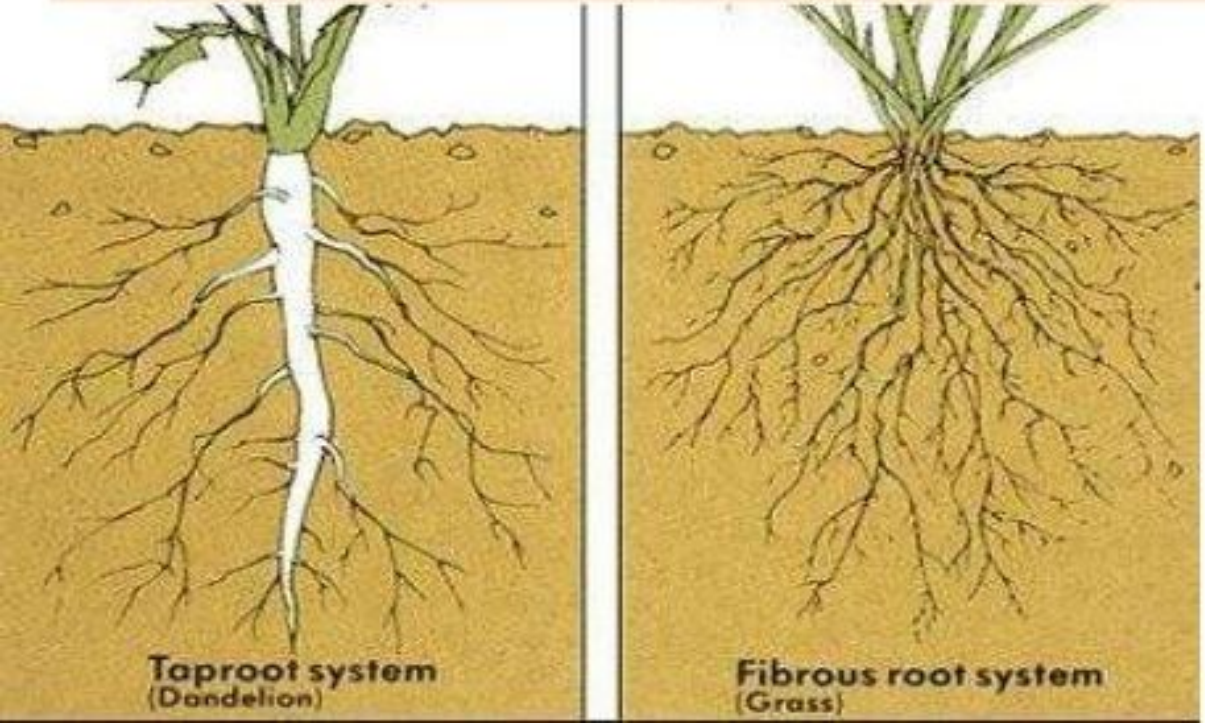
The root system is a set of roots of one plant. The general form and character of which is determined by the ratio of the growth of the tap, lateral and adventitious roots.

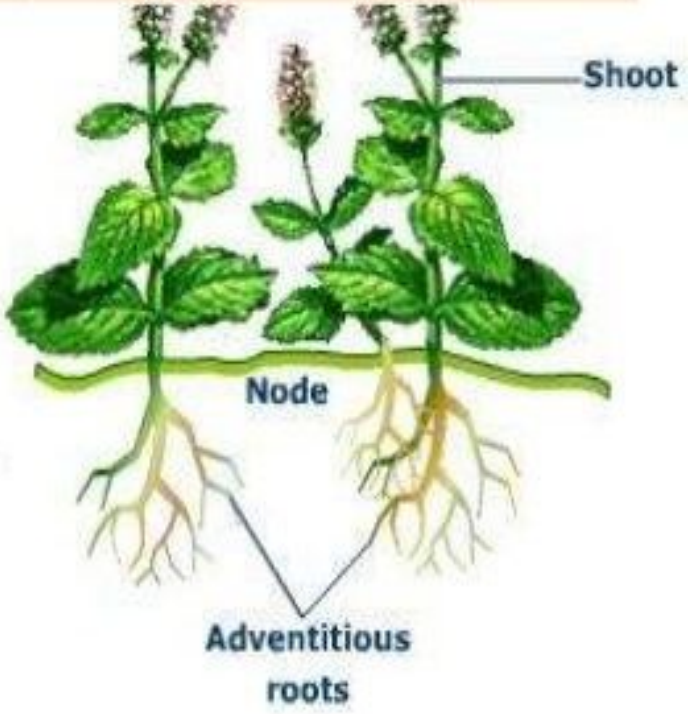


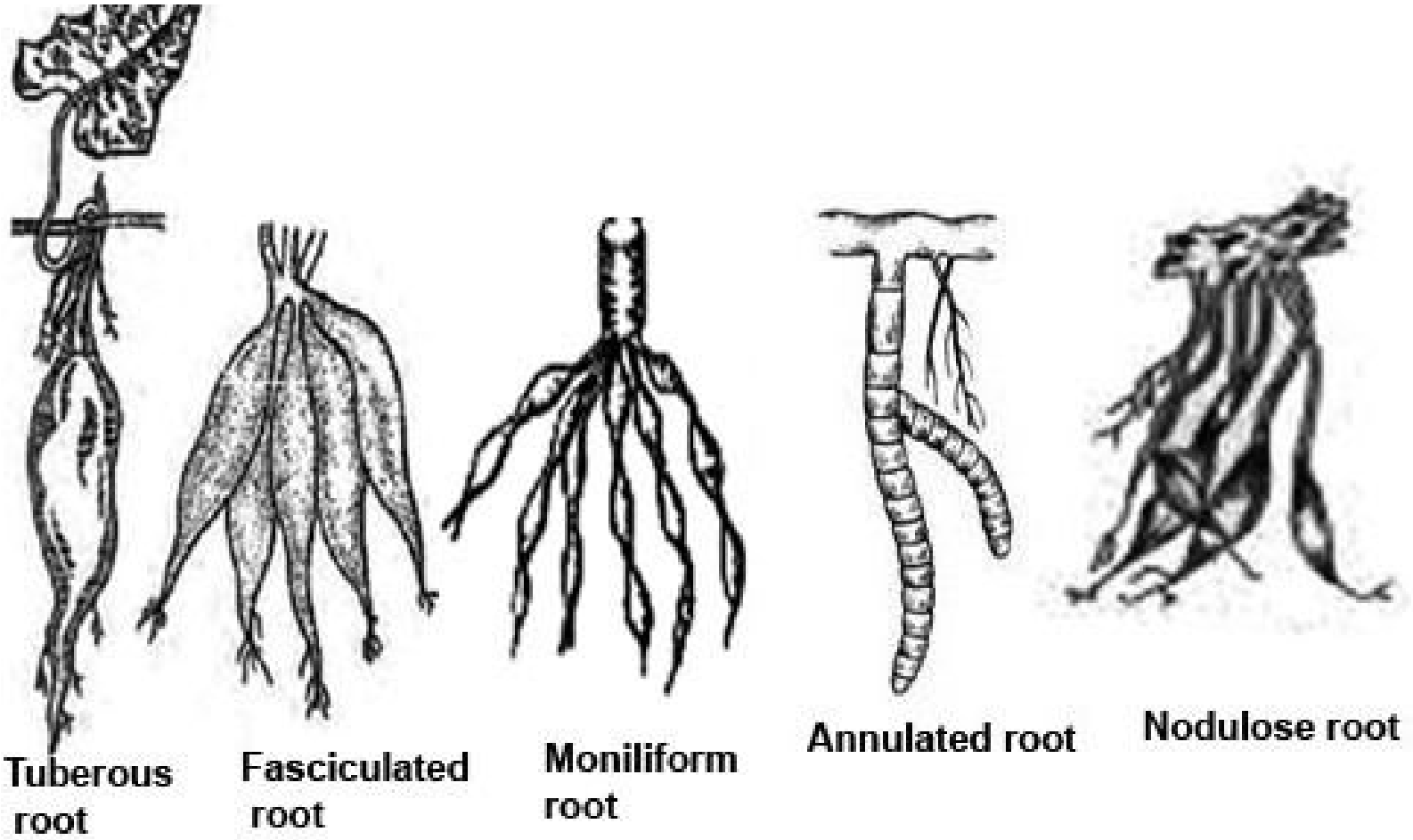
А — pivotal root system , *Б* — fibrous root system , *В* — mixed root systems ; *1* — tap root, *2* — adventitious rot, *3* — hypocotyl.

TYPES OF ROOT SYSTEMS

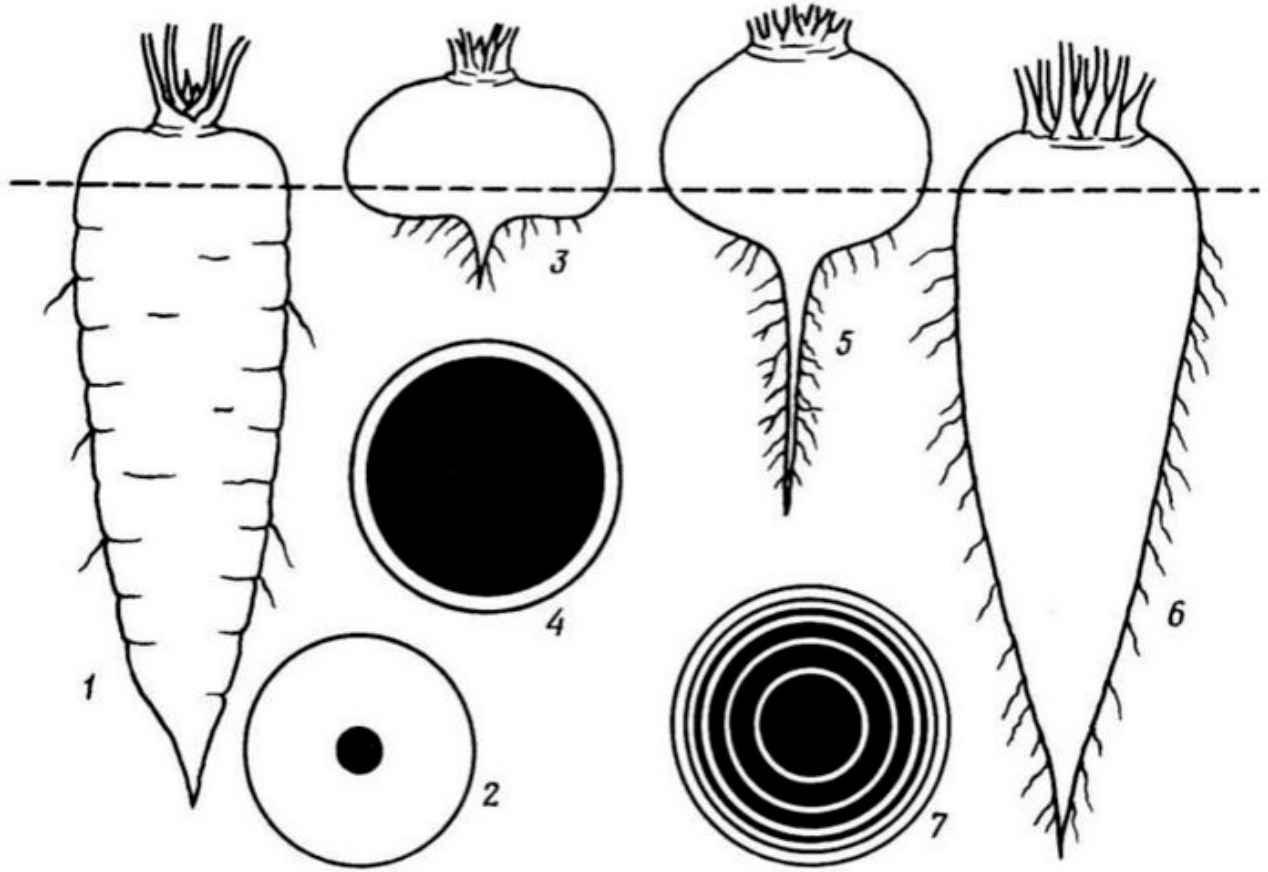
TAP ROOTS	FIBROUS ROOTS	ADVENTIOUS ROOTS
•Prominent in dicot	•Prominent in monocots	•They develop from organs
•Primary roots grow & becomes stout.	•Roots develop from lower nodes	Of shoot system
•Secondary & tertiary grow from primary root	•They have same length & diameter	






Tuberous root
Fasciculated root
Moniliform root
Annulated root
Nodulose root

Root crop of carrot (1, 2), turnip (3, 4) and beet (5, 6, 7)



(on the cross cut the xylem marked by black color; horizontal line – a border between stalk and root)

The Banyan Tree is a species of fig tree that grows aerial prop roots; thick supporting trunks. Prop roots allow the Banyan Tree to provide additional anchorage and support. The circling of prop roots allows these enormous trees to not only grow taller but also wider. A large Banyan Tree can be over 100 feet(30 meters) wide.

Buttress roots of Fig trees arise from the base of a stem and support the plant.

Roots of mangrove trees

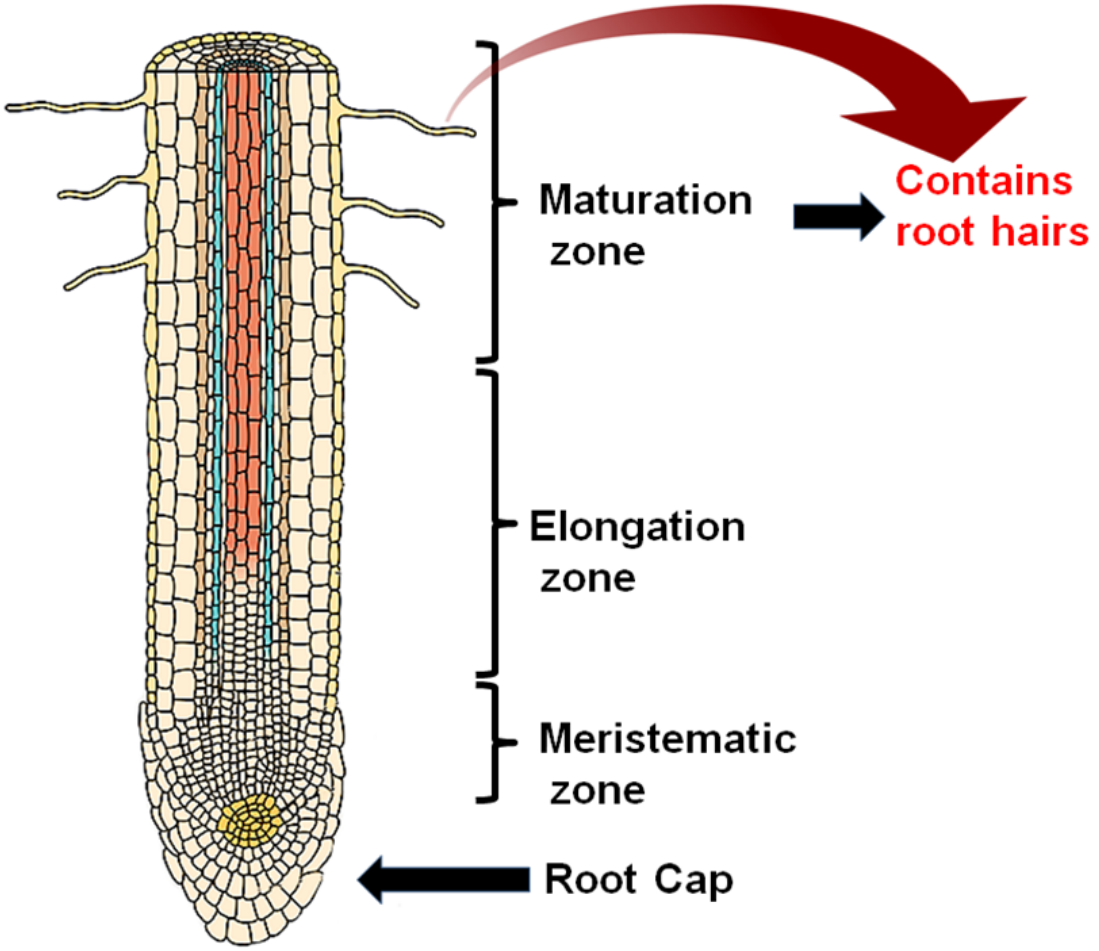
Ivy roots of Hedera helix

Root functions

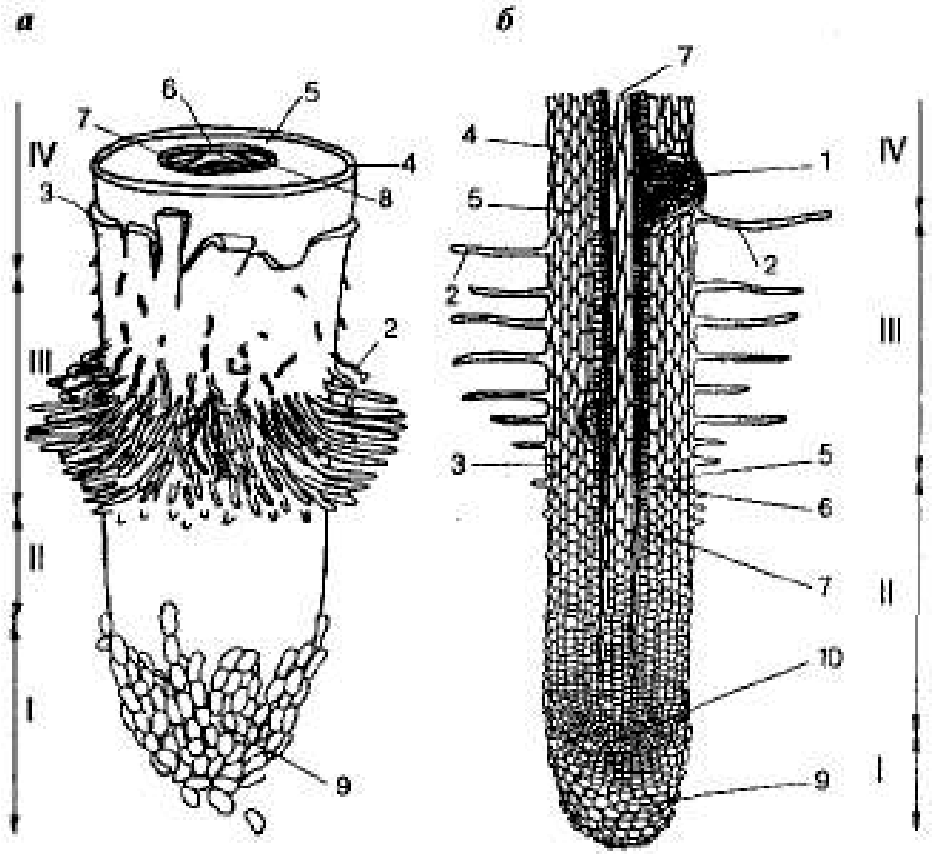
- 1. Mineral and water nutrition.
- 2. Fixing the plant in the soil.
- 3. Synthesis of organic substances.
- 4. Synthesis of alkaloids, phytohormones and other active compounds.
- 5. Accumulation of substances.
- 6. Vegetative reproduction.
- 7. Symbiosis with bacteria.
- 8. Symbiosis with fungi (mycorrhiza)

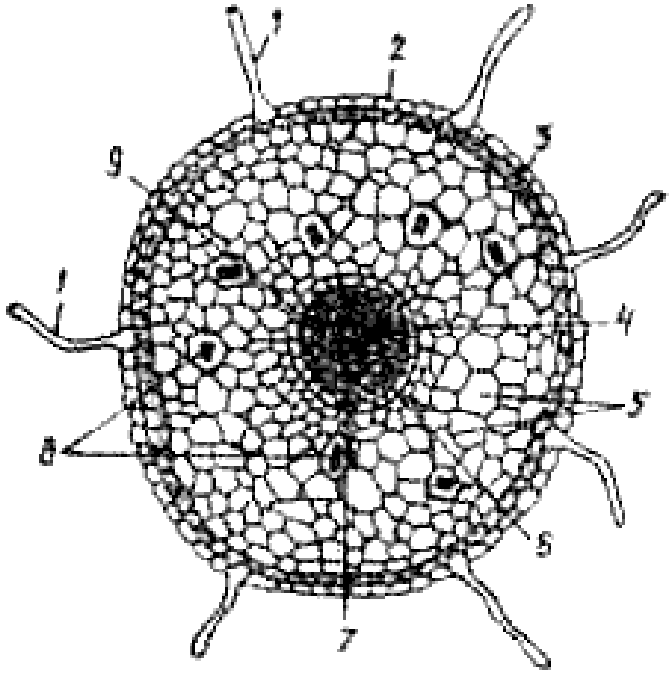
- Roots **absorb water and minerals** from the soil and **transport** them to the upper parts like stem and leaves of the plant. The water and minerals are carried from roots to the upper parts of the plants in an upward movement, against the gravity. Therefore, it requires some force. This force is provided by the **transpirational pull** due to the process of transpiration going on in the leaves.
- Roots also provide **anchorage** to the plants and keep them attached to the soil by binding the soil around the roots. This is the reason why it is difficult to uproot a plant by hands.
- Roots are used to **store food;** for example, fleshy roots like Carrot, Radish, Beet, Turnip, and Mirabilis.
- Roots play an essential role in binding the soil. Roots help in **preventing soil erosion** and land sliding in the hilly areas.
- Roots of plants like Corms, Stem Tubers, Rhizomes, and Stolon participate in **vegetative reproduction.**
- In some week stemmed plants, roots help in clinging and, hence, **climbing roots;** for example, Money Plant, Betel, Ivy, etc.
- Roots also take part in **nitrogen fixation** with the help of nitrogen-fixing bacteria present in the soil. For example, nodulated roots Of Pea, Bean, Gram, Fenugreek, etc.
- Roots of some plants are present above the ground and known as **Aerial Roots**. For example, pneumatophores are the type of specialized aerial roots present in Mangrove plants. They help the plant to breathe.
- Roots of mangrove and epiphytic orchids play a significant role in the **photosynthesis**. They become green upon exposure to light and start producing energy. There is even a leafless orchid *(Dendrophylax lindenii)* which solely depends upon its roots for energy production.

Zone of root

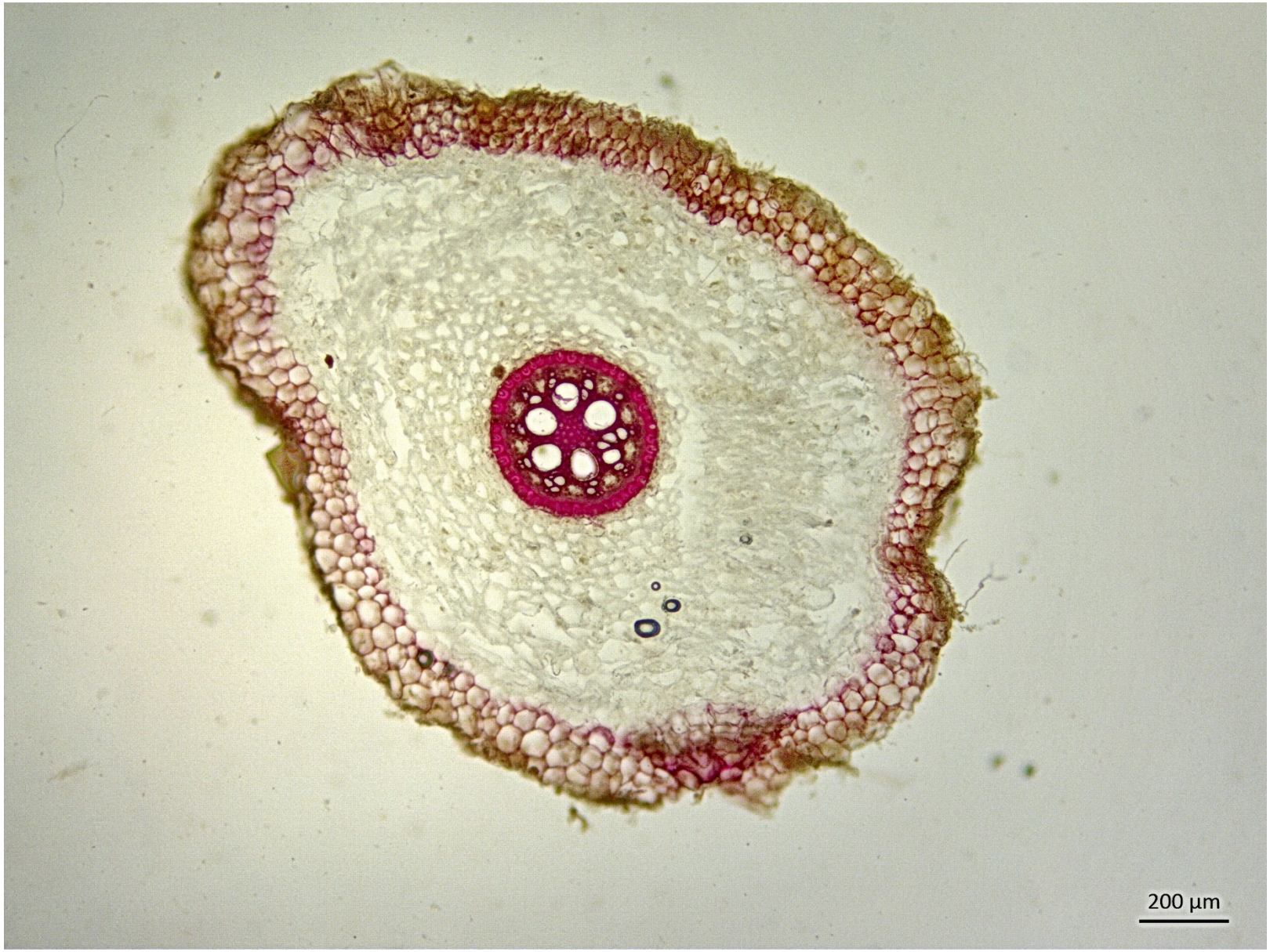

Maturation zone
Contains root hairs
Elongation zone
Meristematic zone
Root Cap

The zone maturation (the absorption zone)

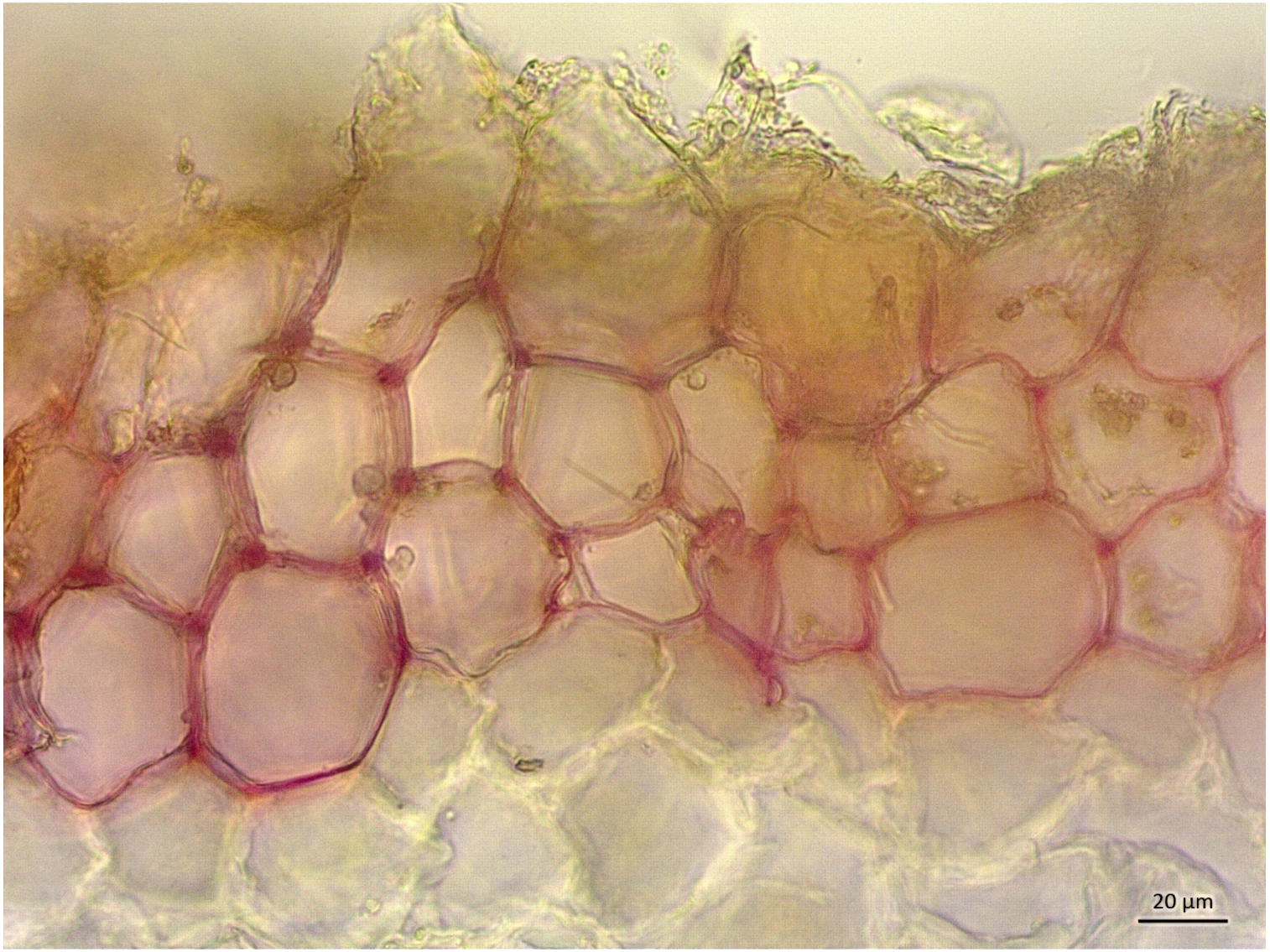


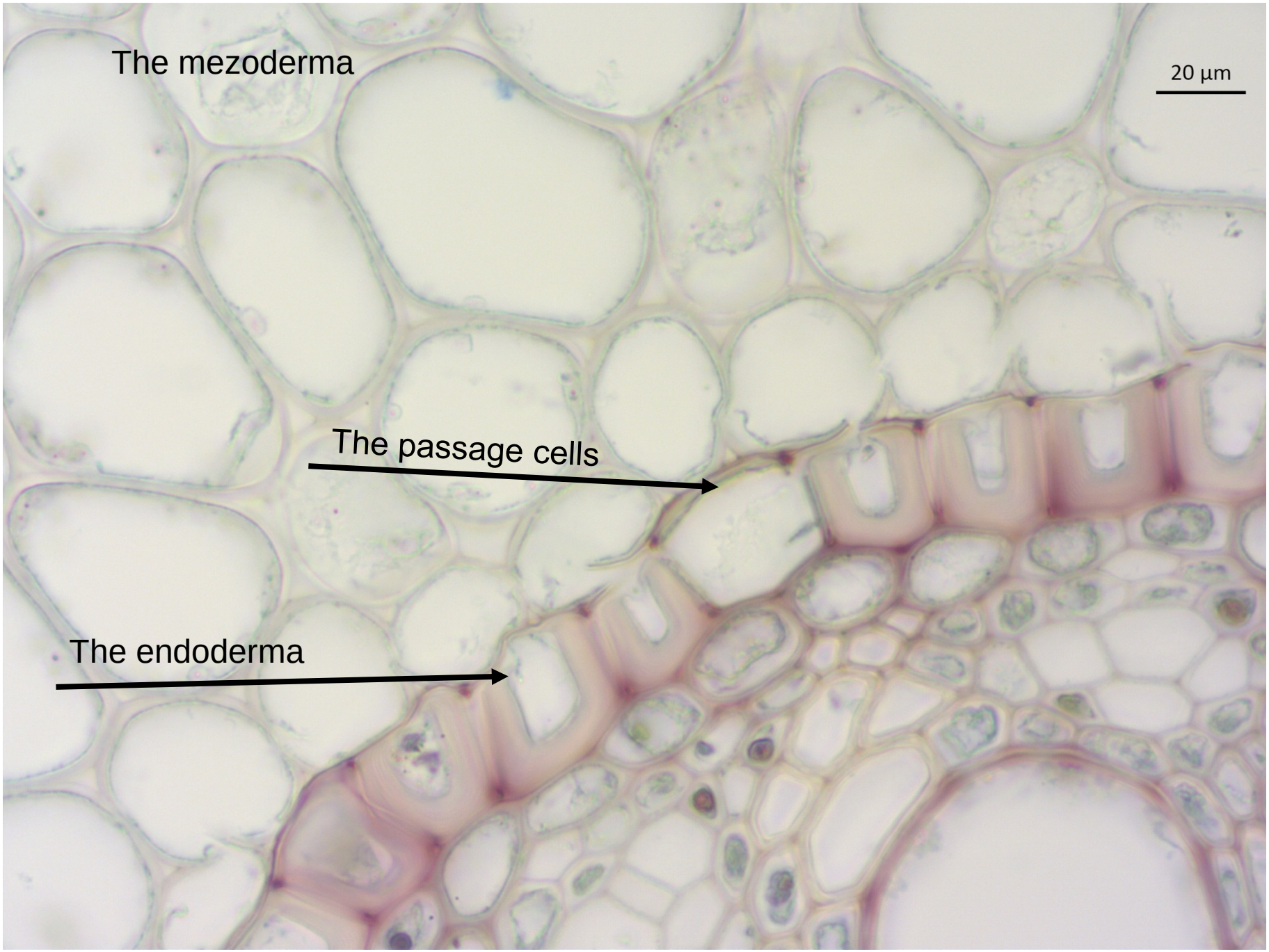


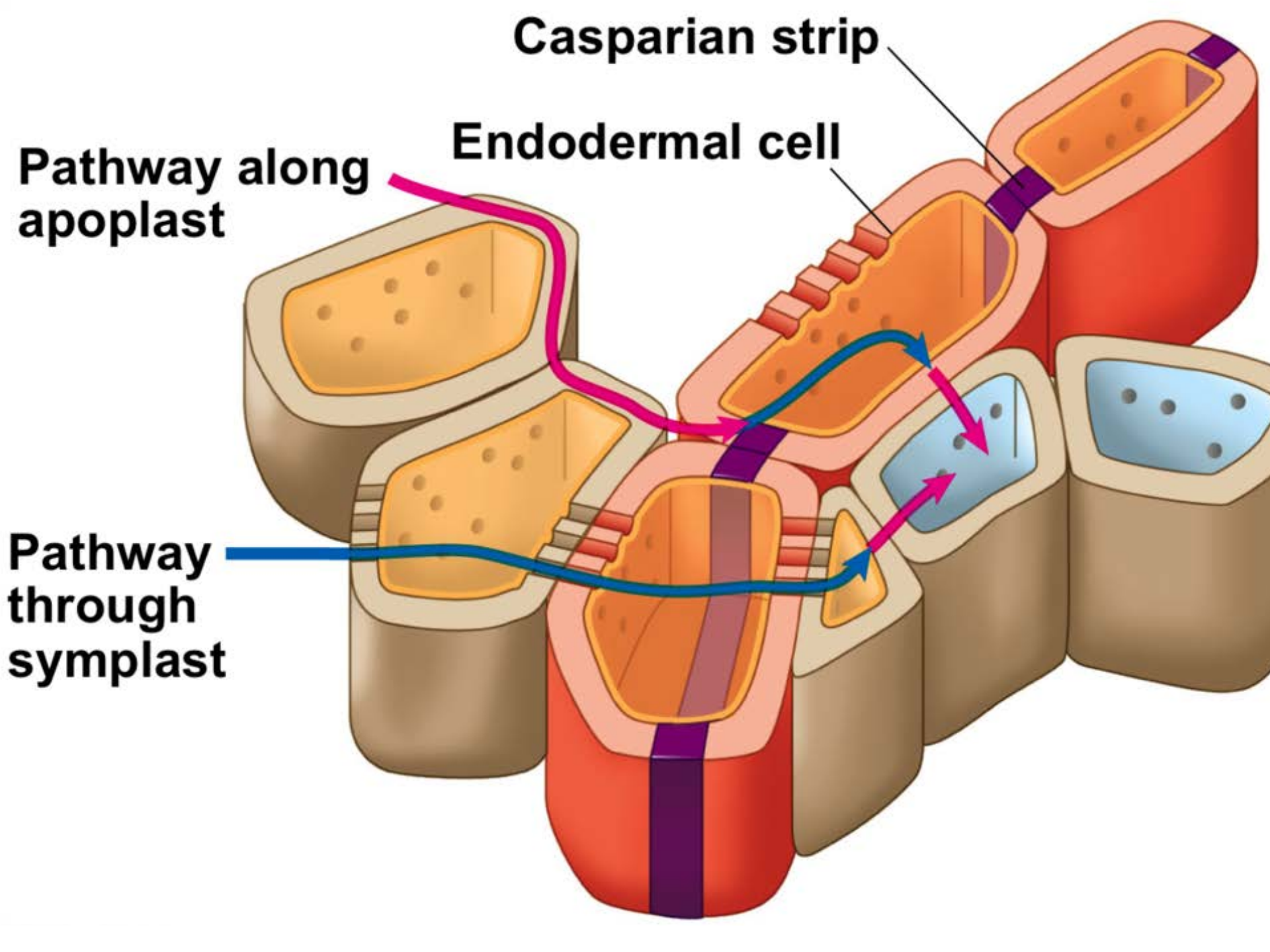
Task 2. Primary structure of the root of monocotyledonous plants using the example of the root of Iris (Iris germanica L.).

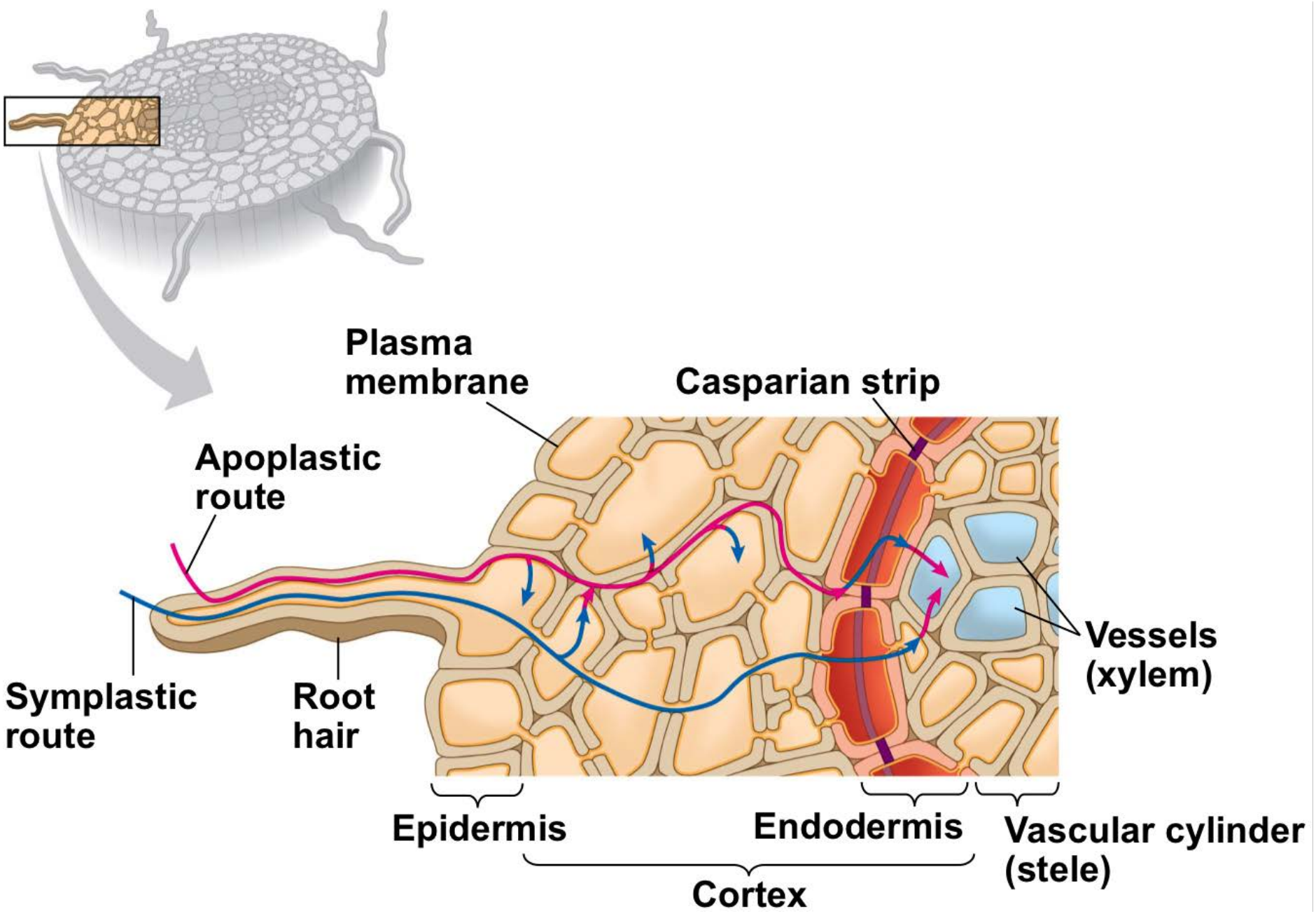


The exodermis cells in root of Iris germanica

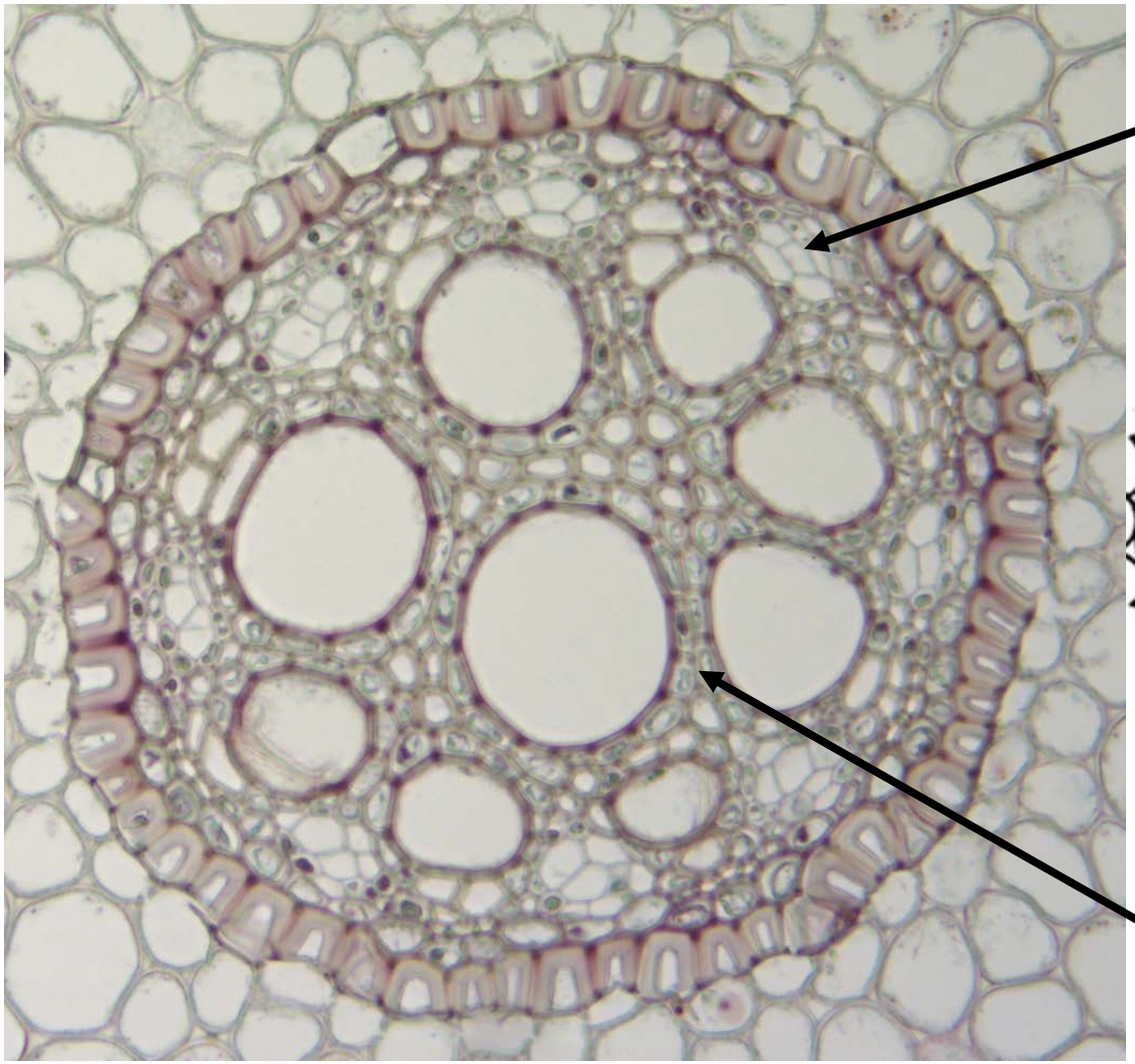



The mezoderma
20 µm
The passage cells
The endoderma

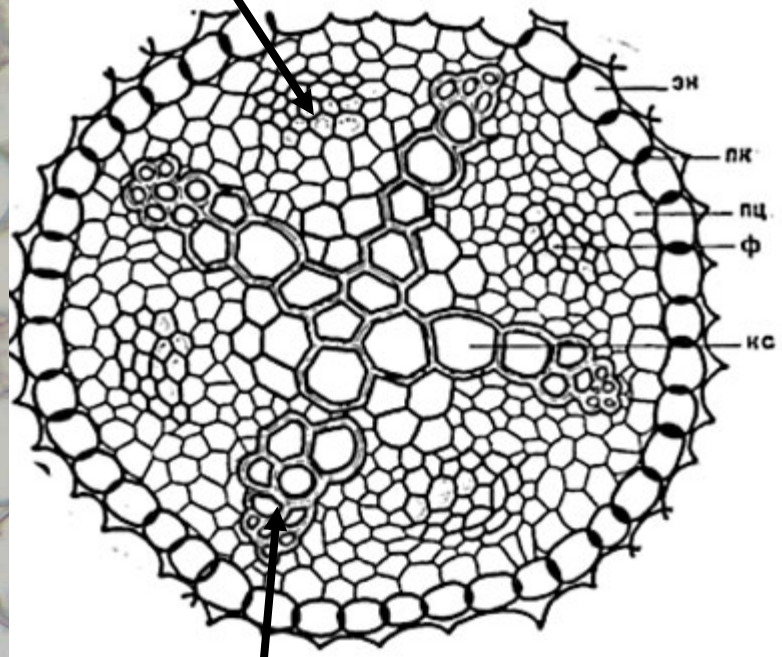

Casparian strip
Endodermal cell
Pathway along apoplast
Pathway through symplast


Plasma membrane
Casparian strip
Apoplastic route
Symplastic route
Root hair
Vessels (xylem)
Epidermis
Endodermis
Vascular cylinder (stele)
Cortex

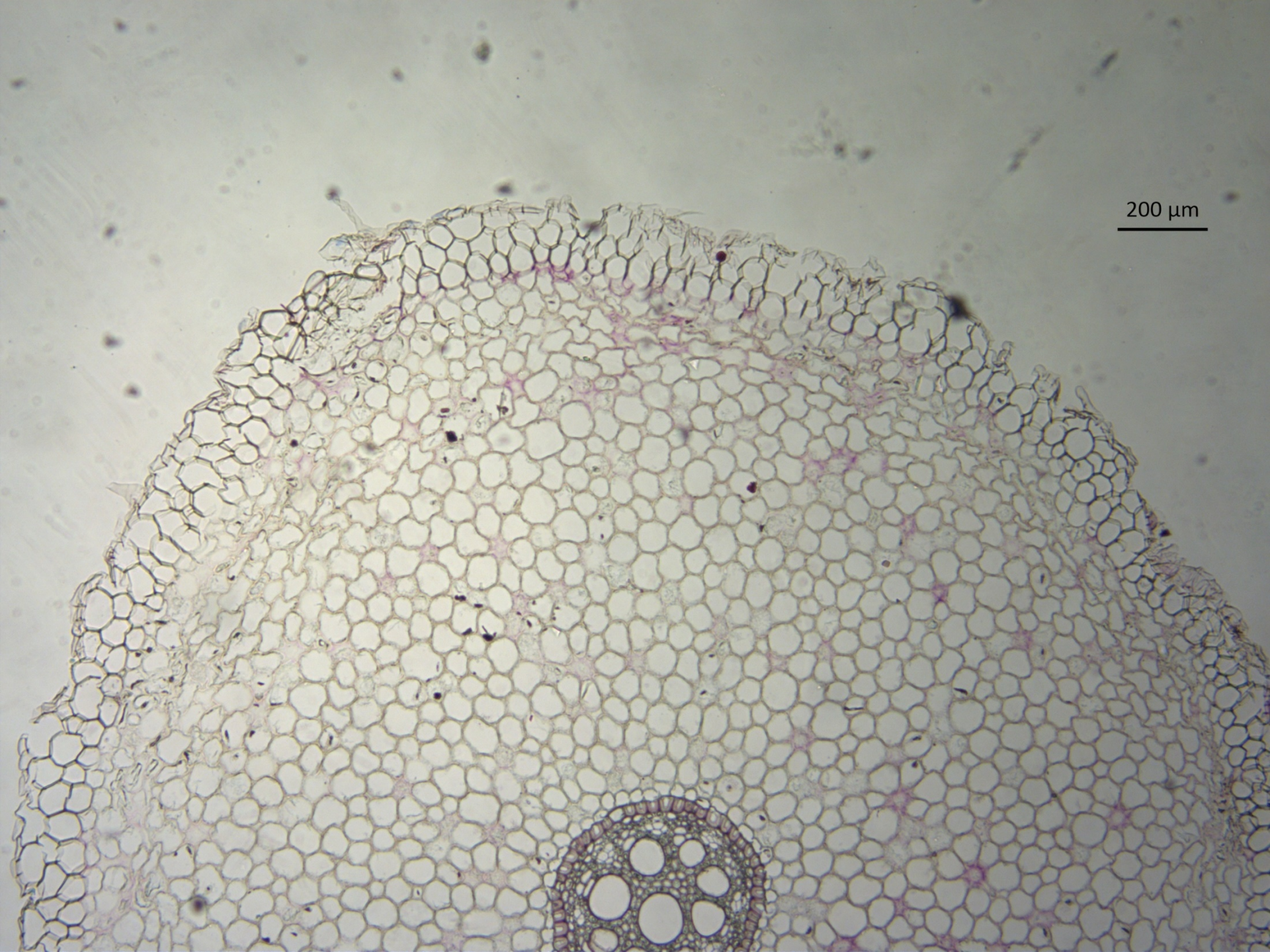
Central axial cylinder

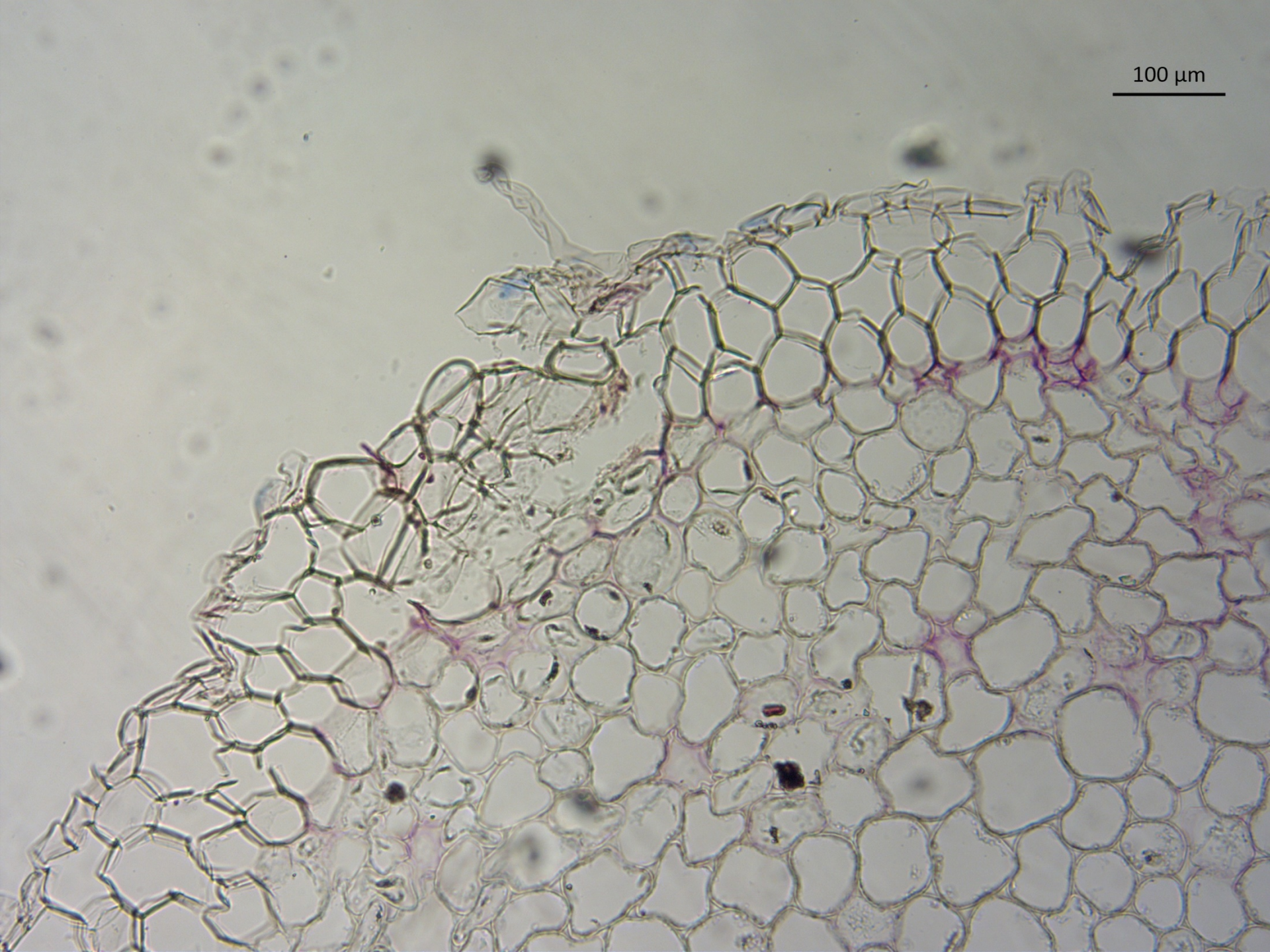


The phloem



The xylem


200 µm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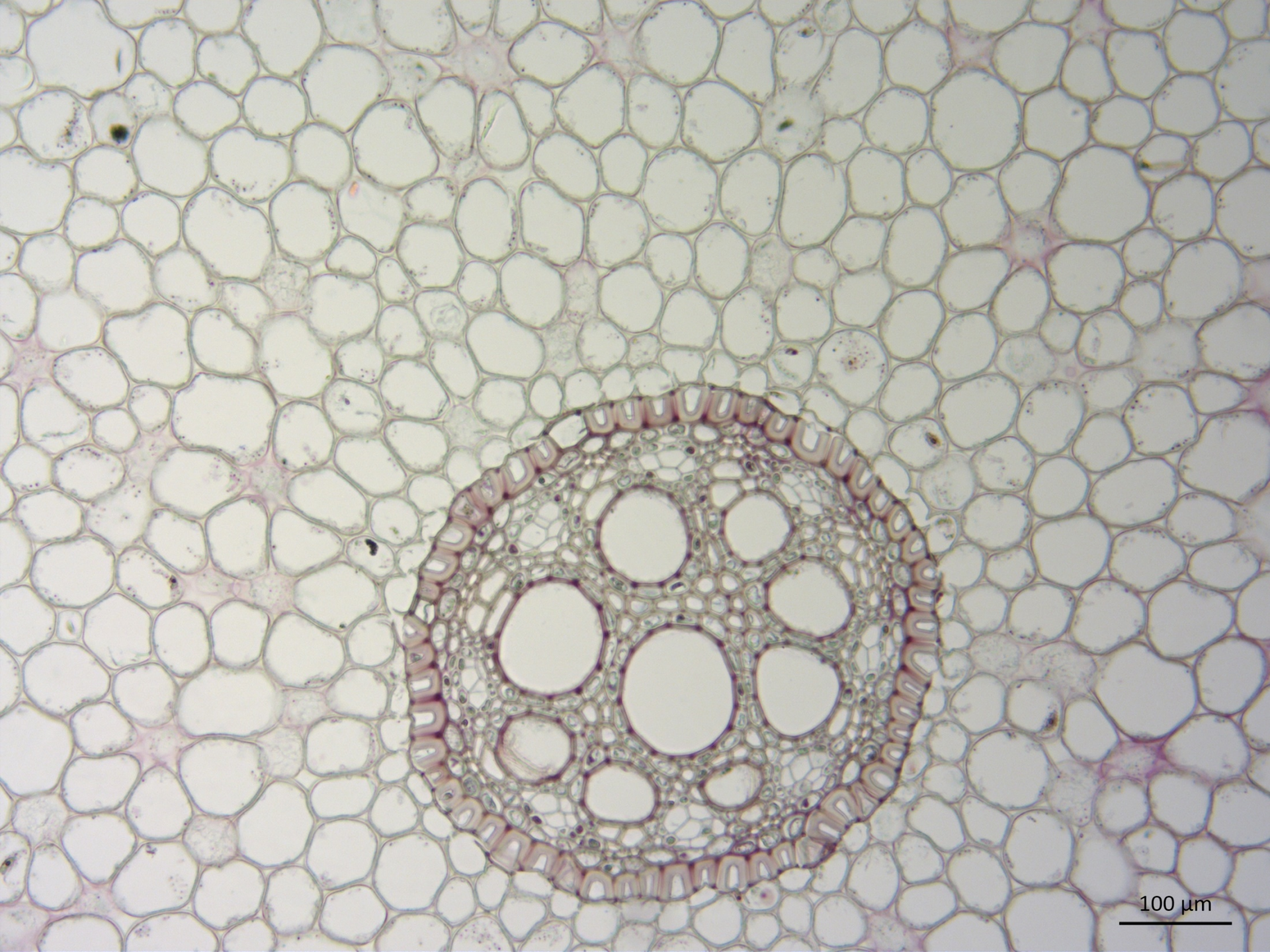
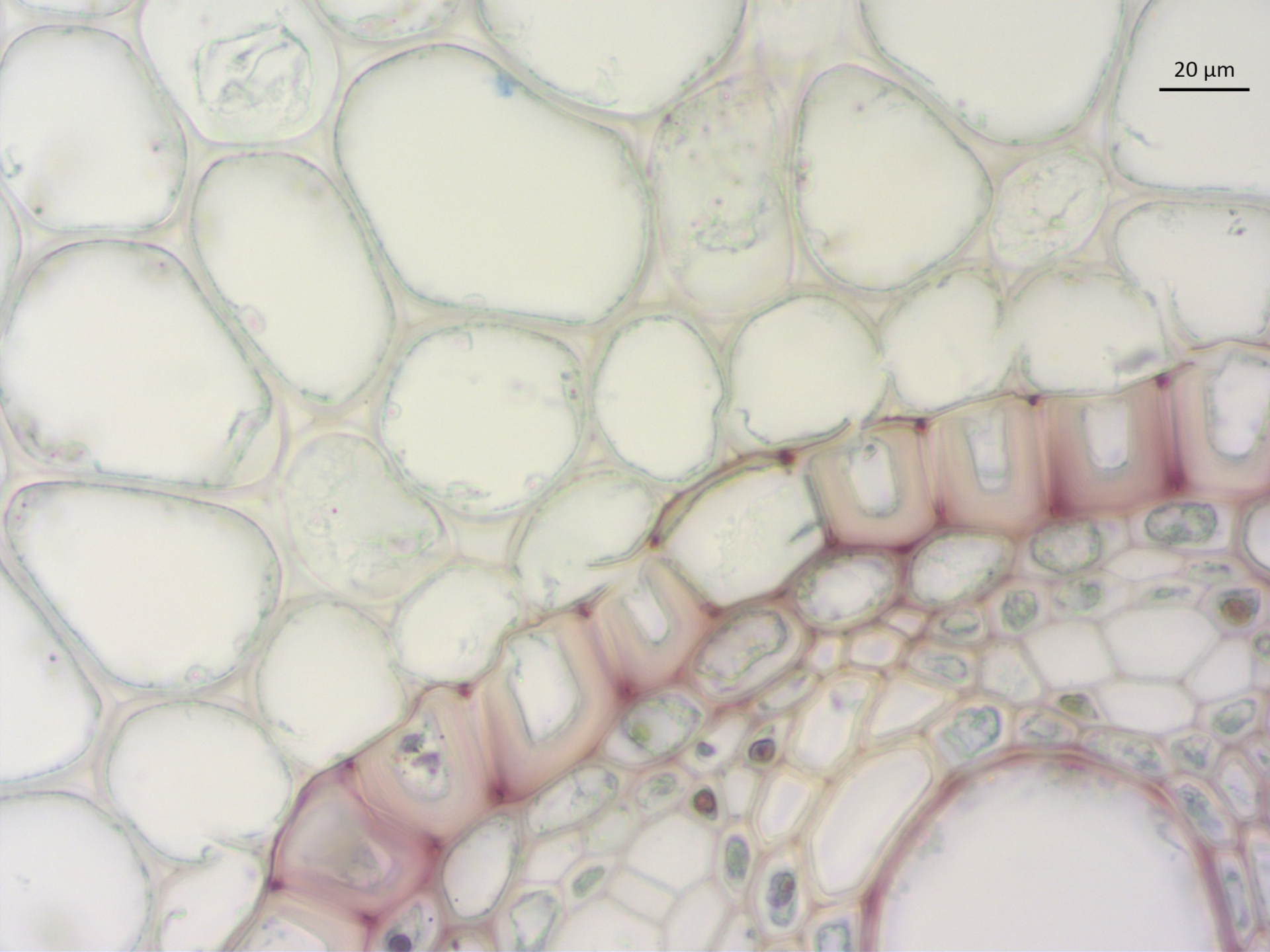
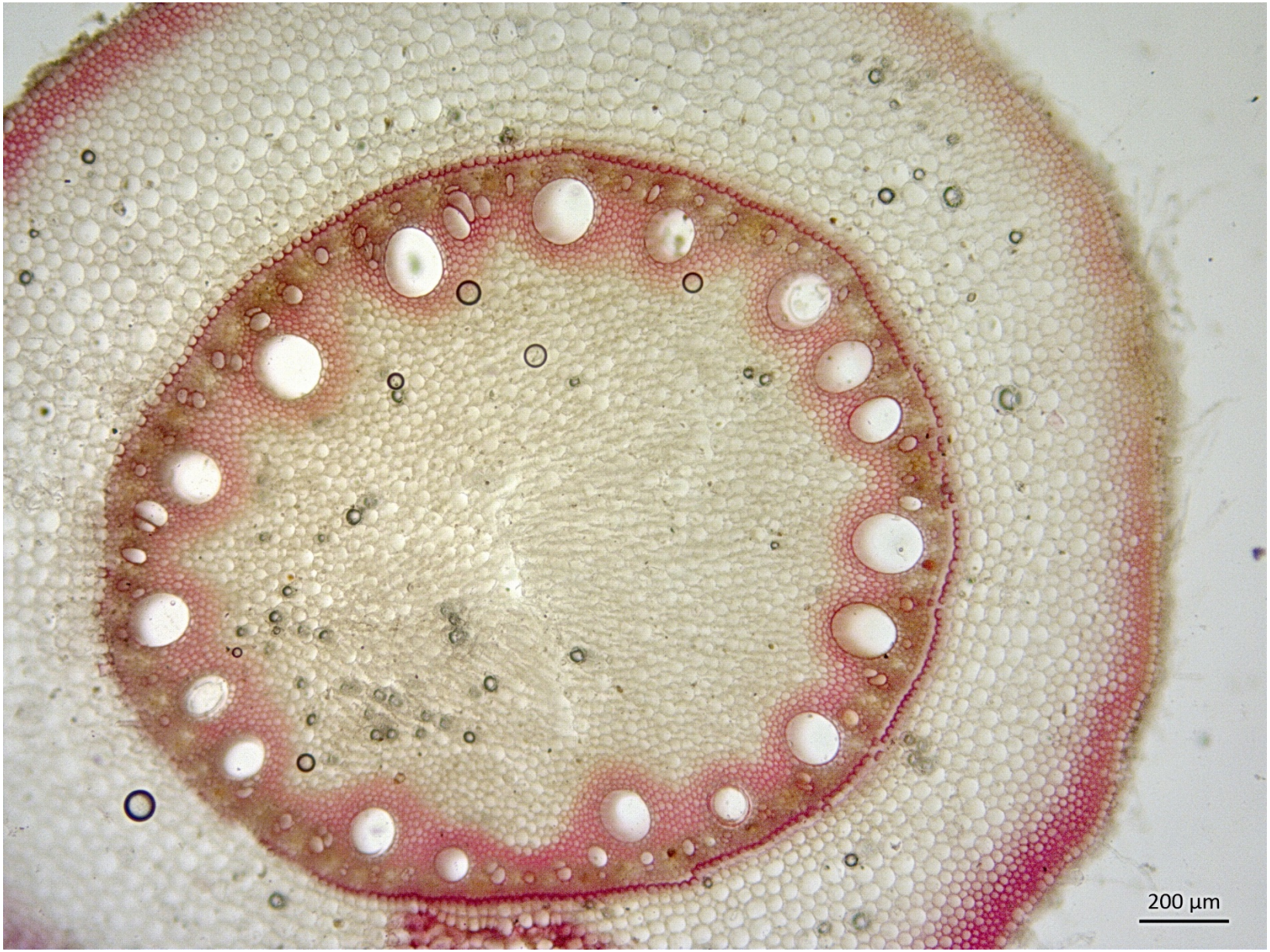
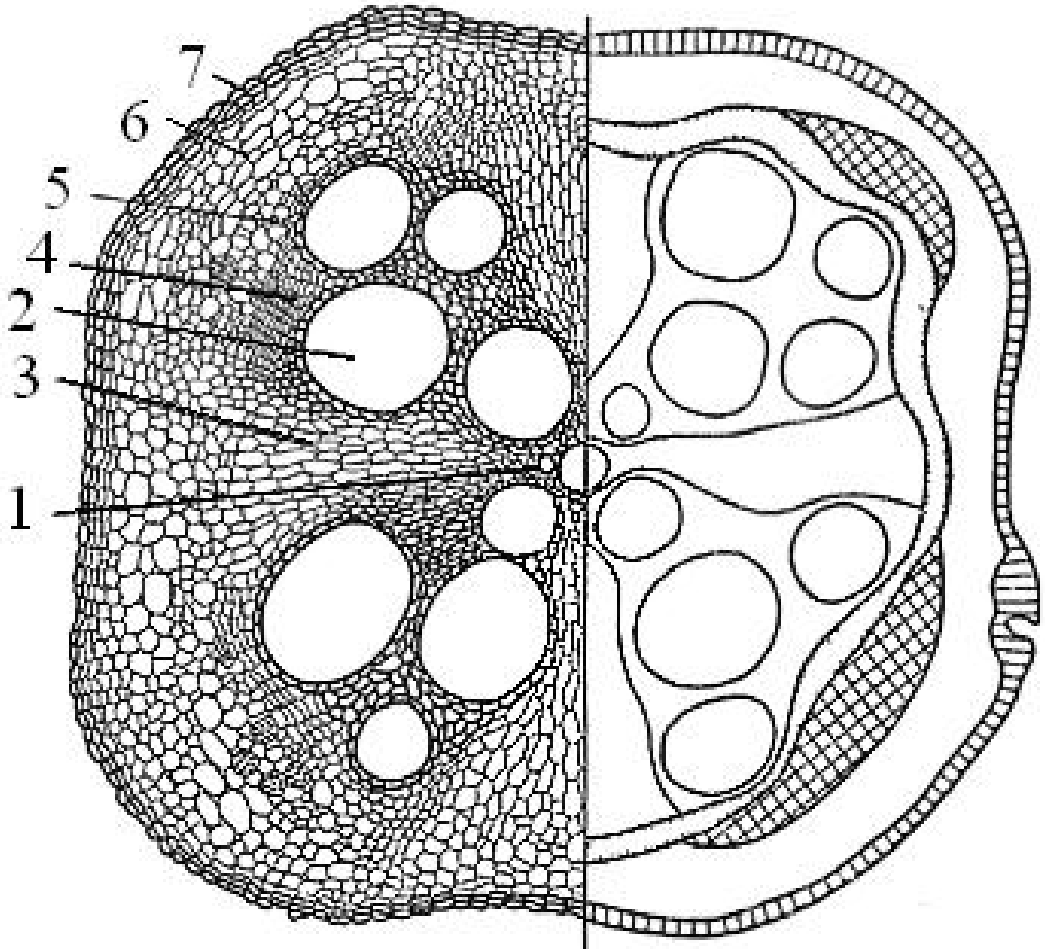

100 µm


20 µm

Additional task: Determine the tissues on the cross-section of the corn root.

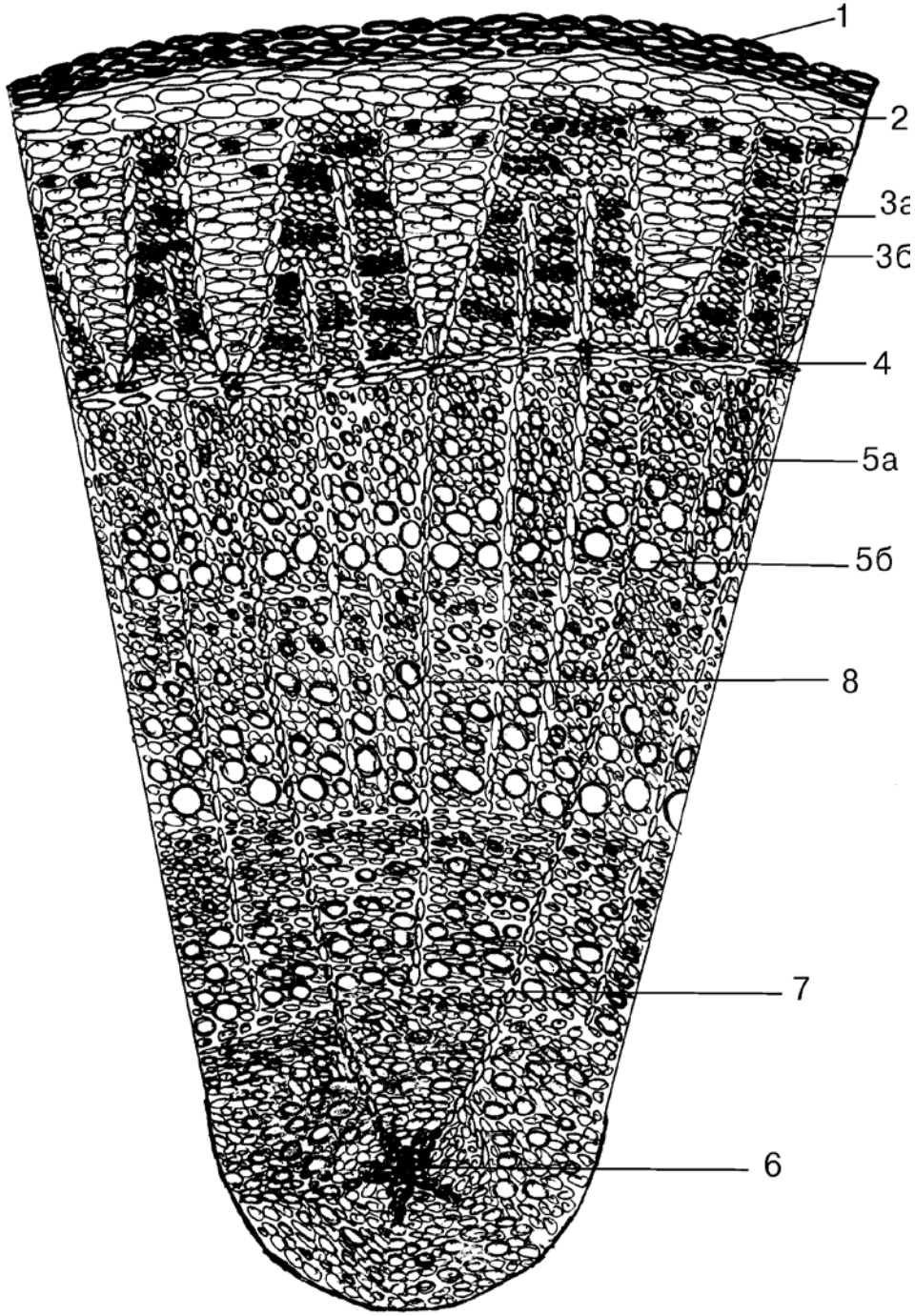


Task 3. Secondary structure of the root of herbaceous dicotyledonous plants by the example of the root of pumpkin (Cucurbita pepo L.).



The secondary structure of the pumpkin root: 1-primary xylem, 2-secondary xylem, 3-pith ray, 4- vascular cambium, 5-primary and secondary phloem, 6- parenchyma of the secondary cortex, 7- periderm (1-3-xylem, 5-7-secondary cortex)

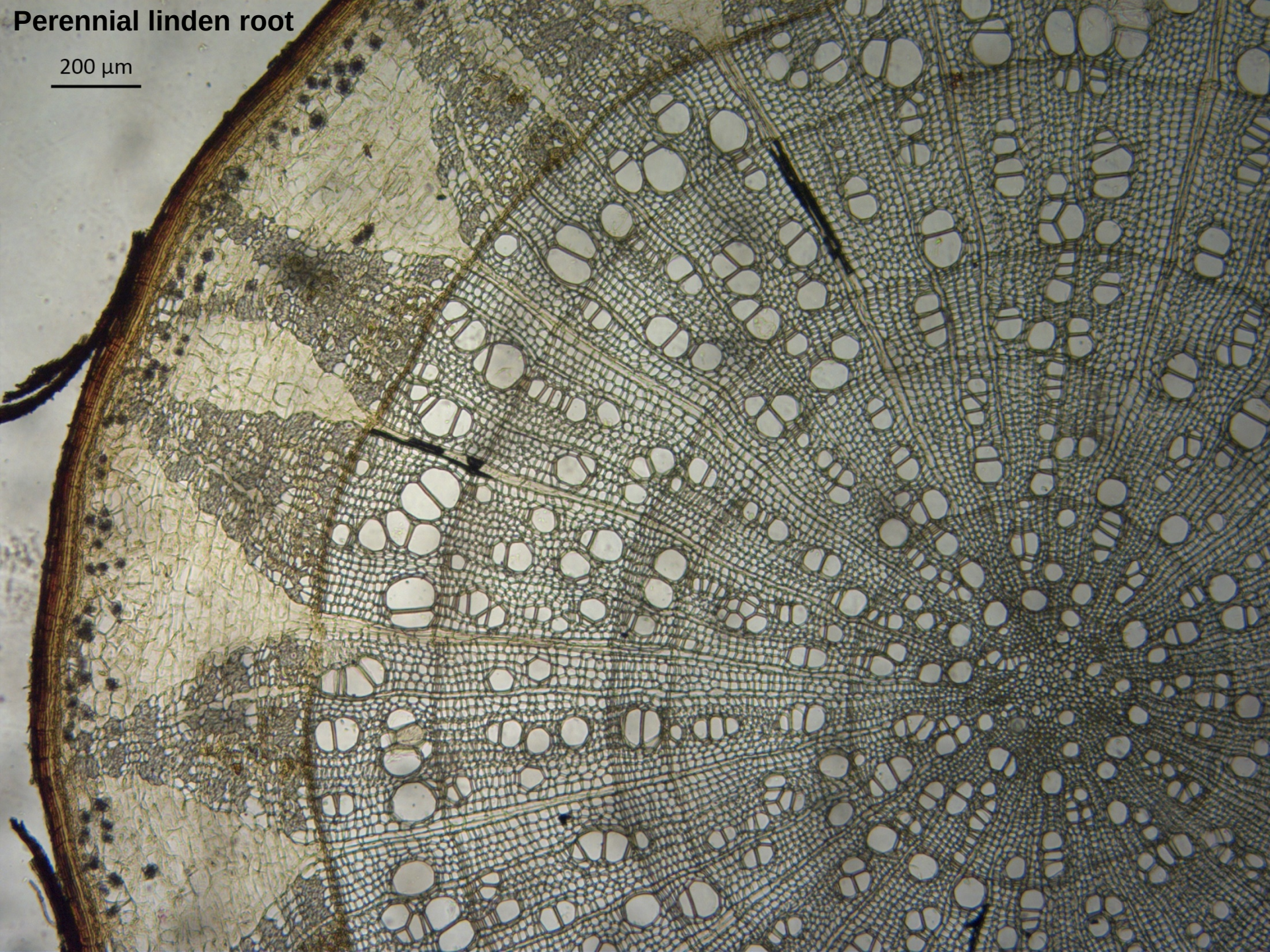
The secondary structure of the pumpkin root

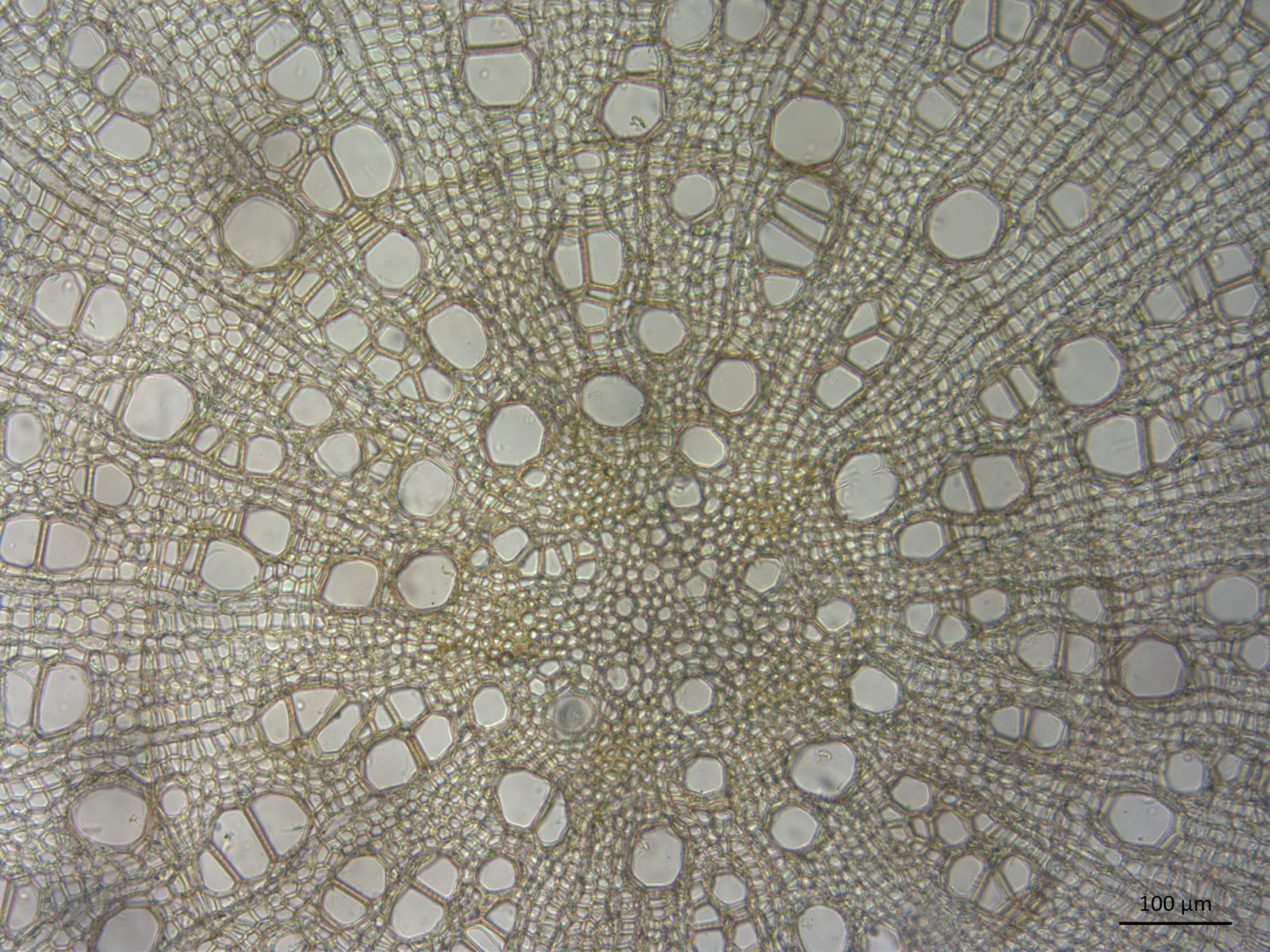


Task 4. Secondary structure of the root of a woody dicotyledonous plant using the root of a linden (Tilia cordata Mill.) as an example.

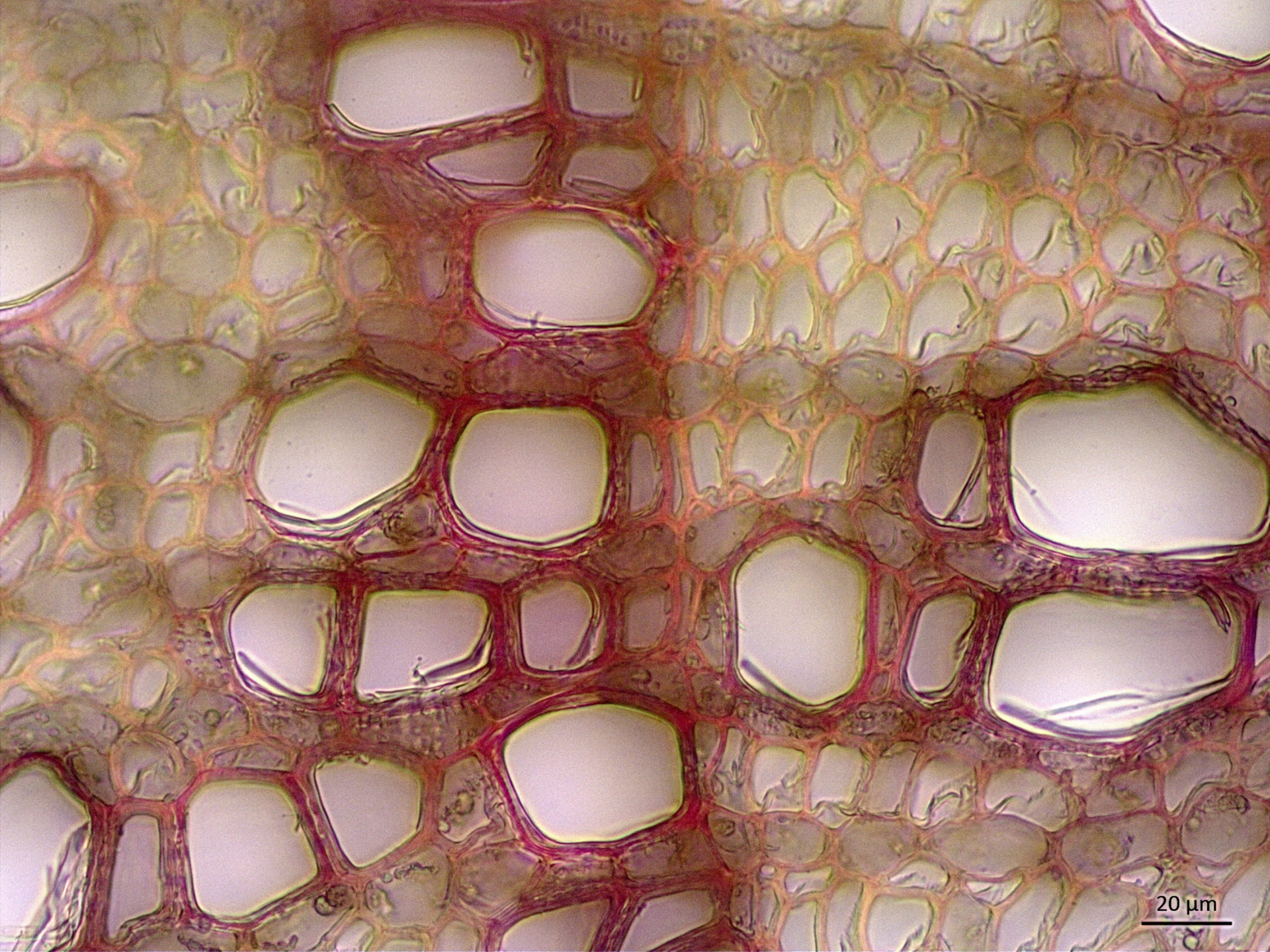
Perennial linden root:

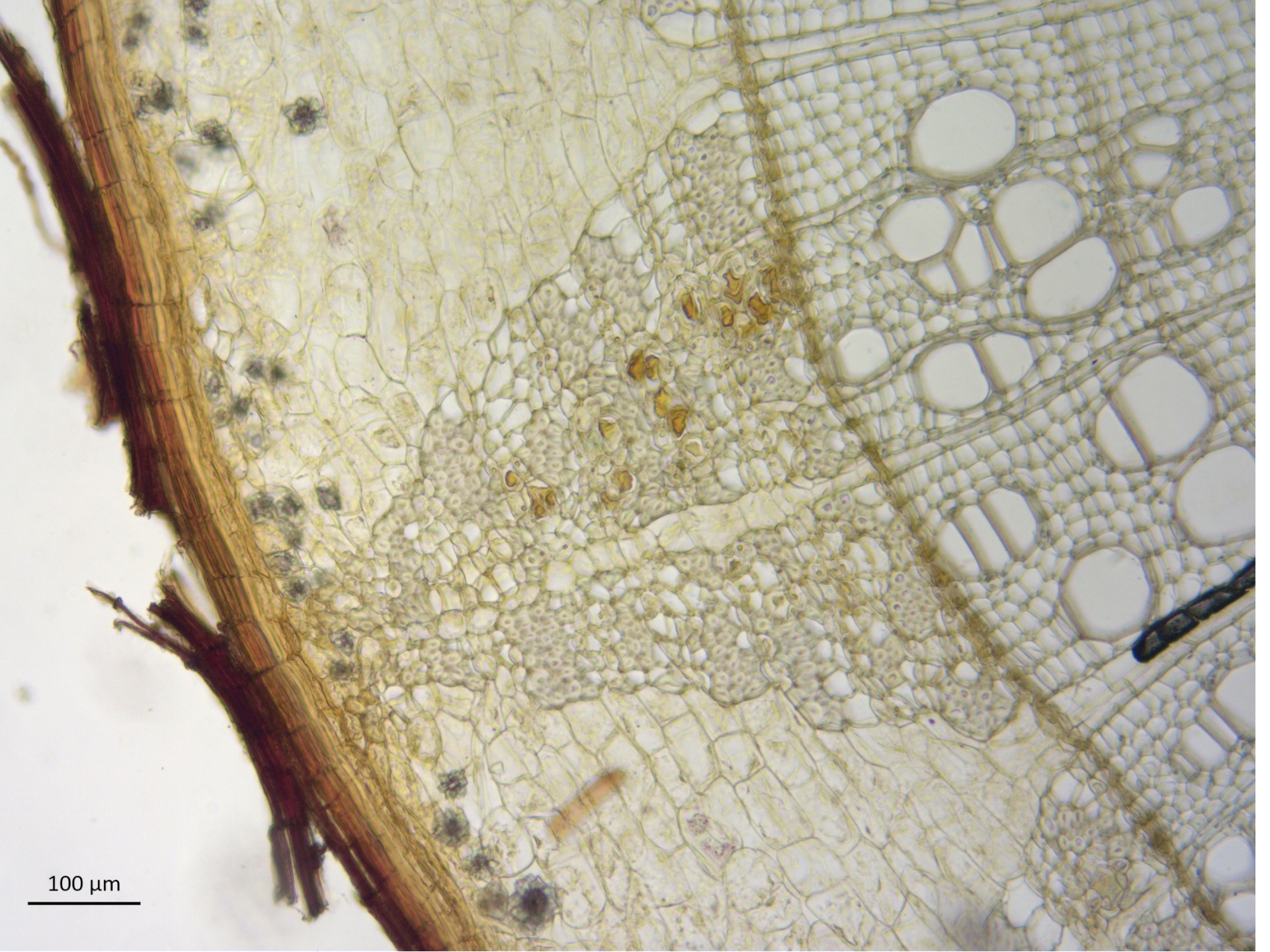
1-periderm, 2-core parenchyma of pericyclic origin, 3-phloem 4- vascular cambium, 5-secondary xylem 6-primary xylem, 7-primary pith ray, 8-secondary pith ray, 9-idioblasts with calcium oxalate crystals


Perennial linden root
200 µm


100 µm


20 µm


20 µm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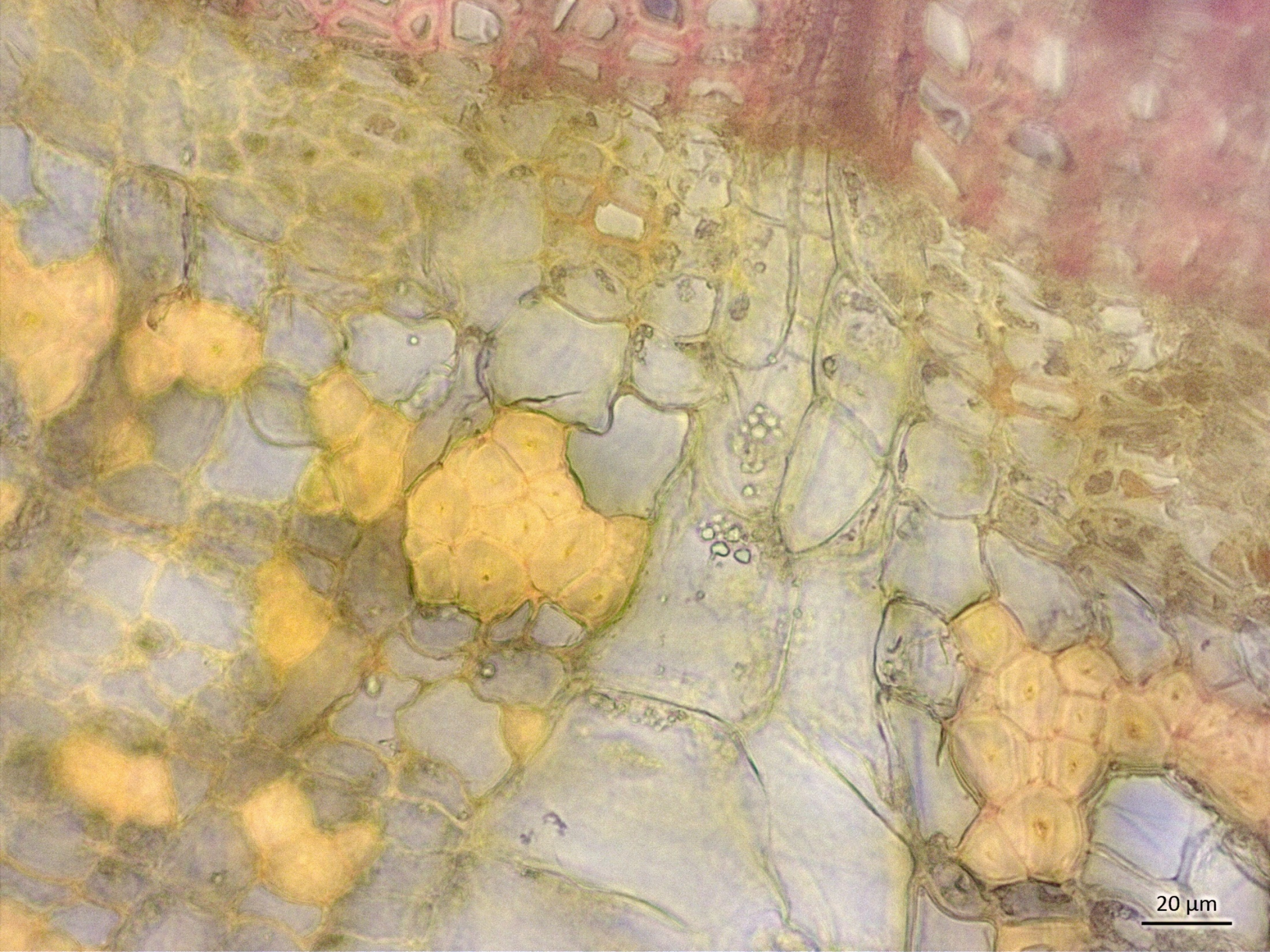
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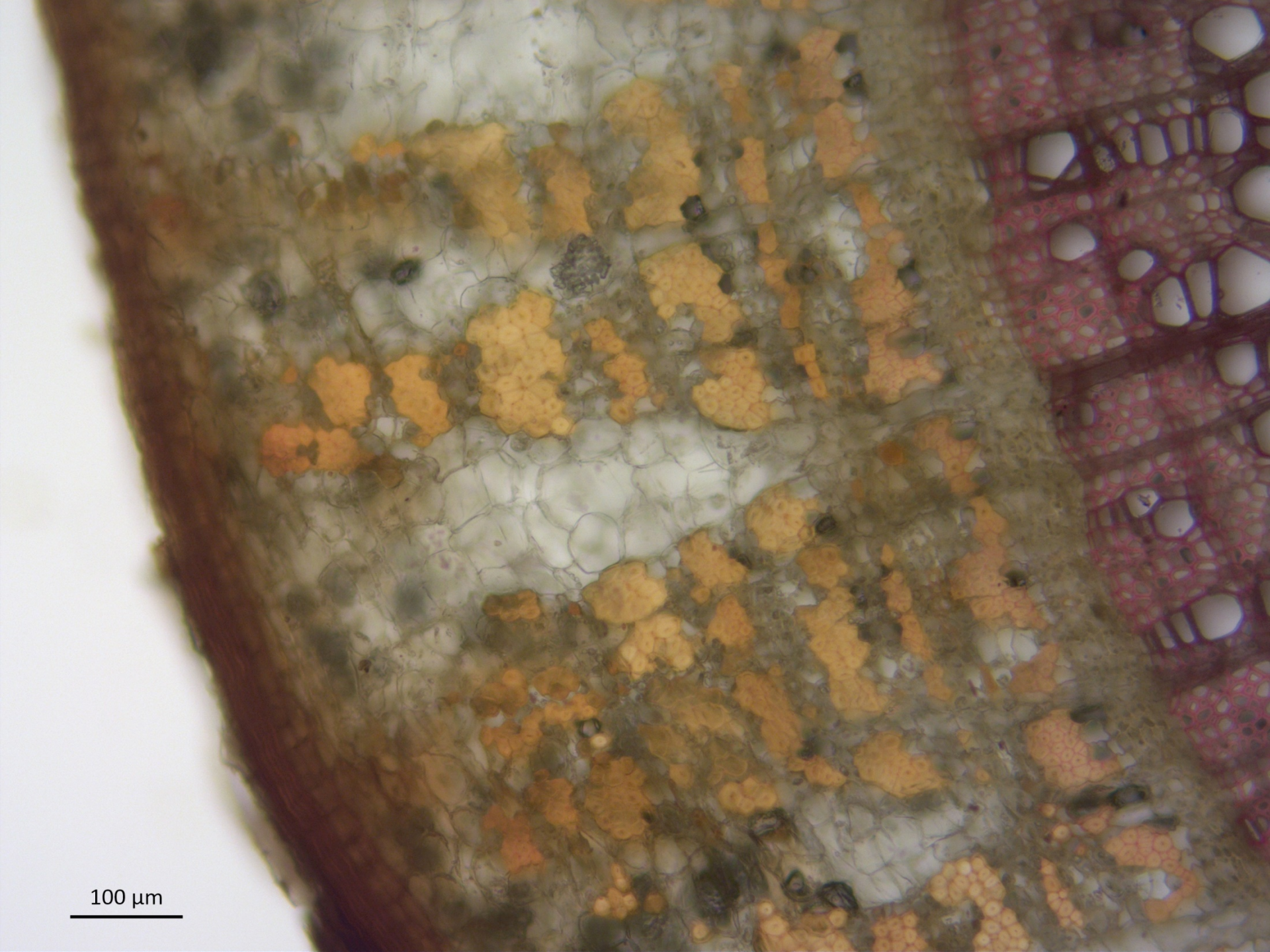
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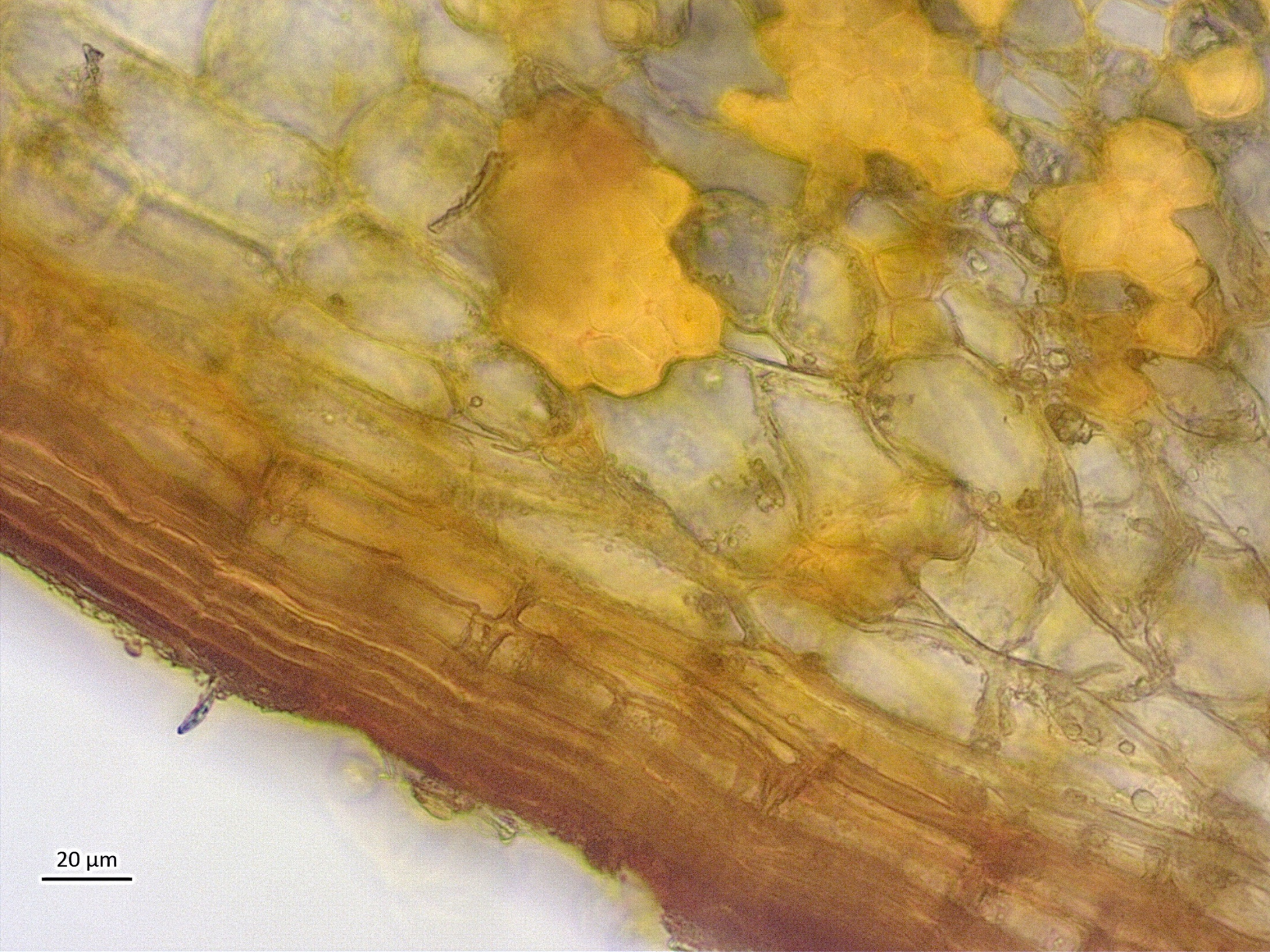
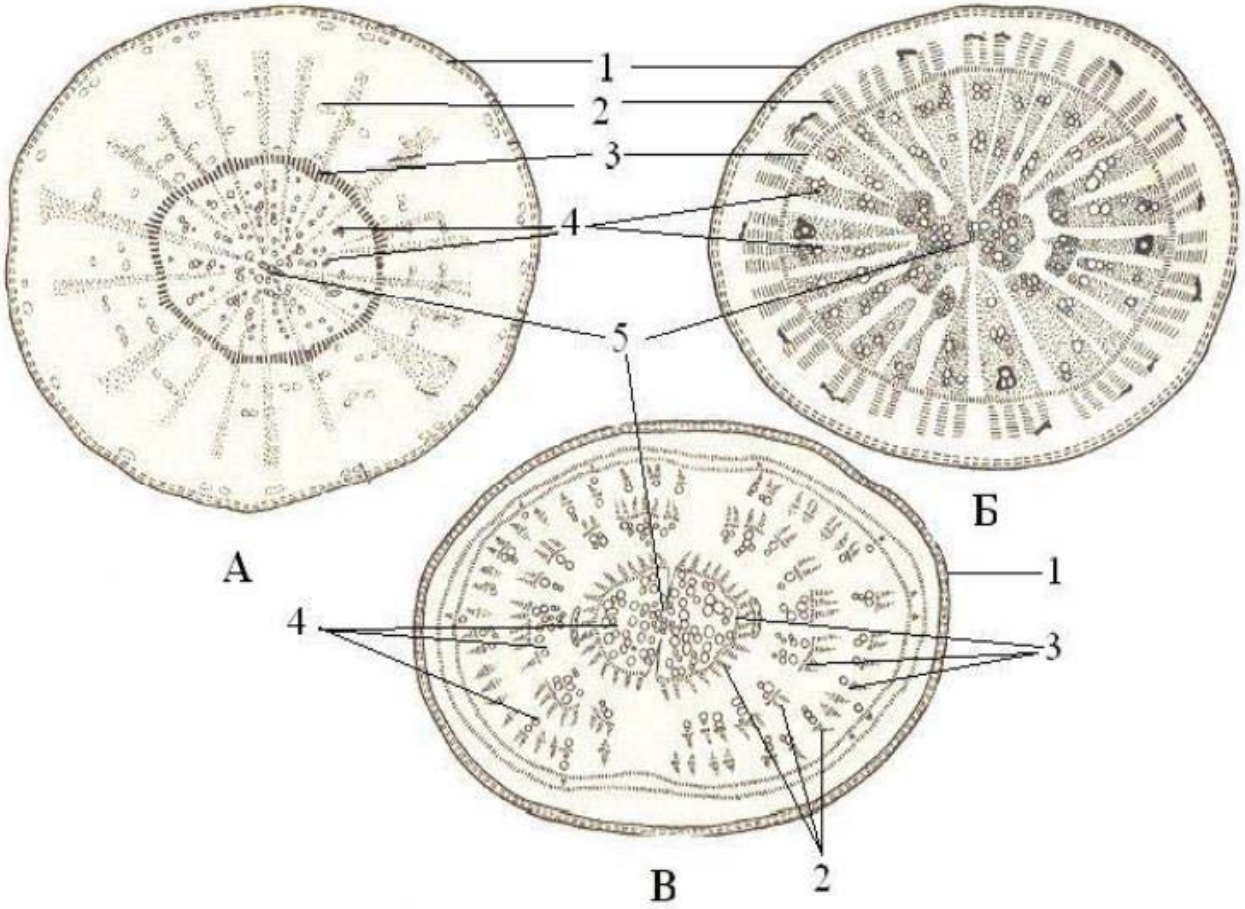
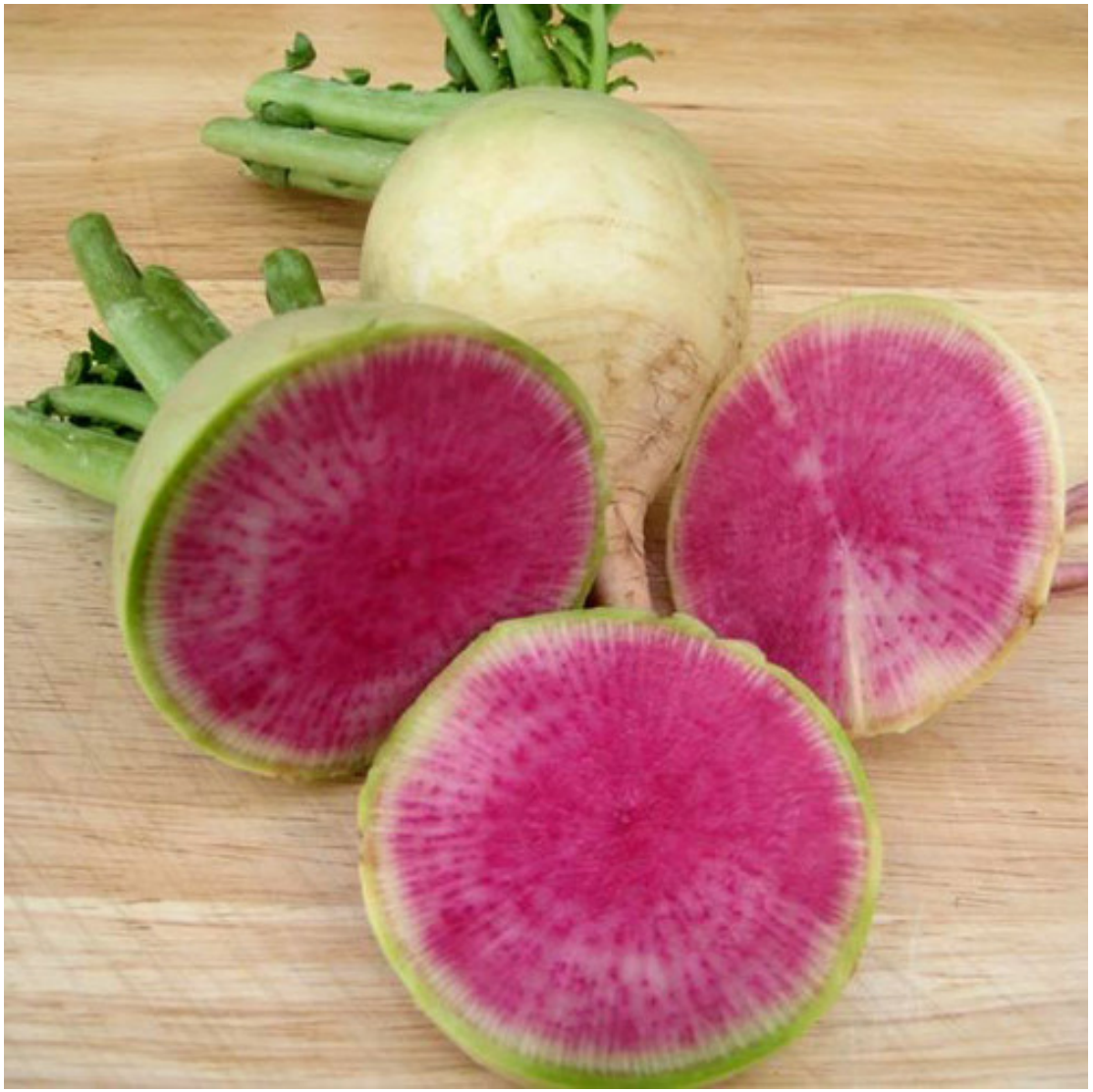

20 µm

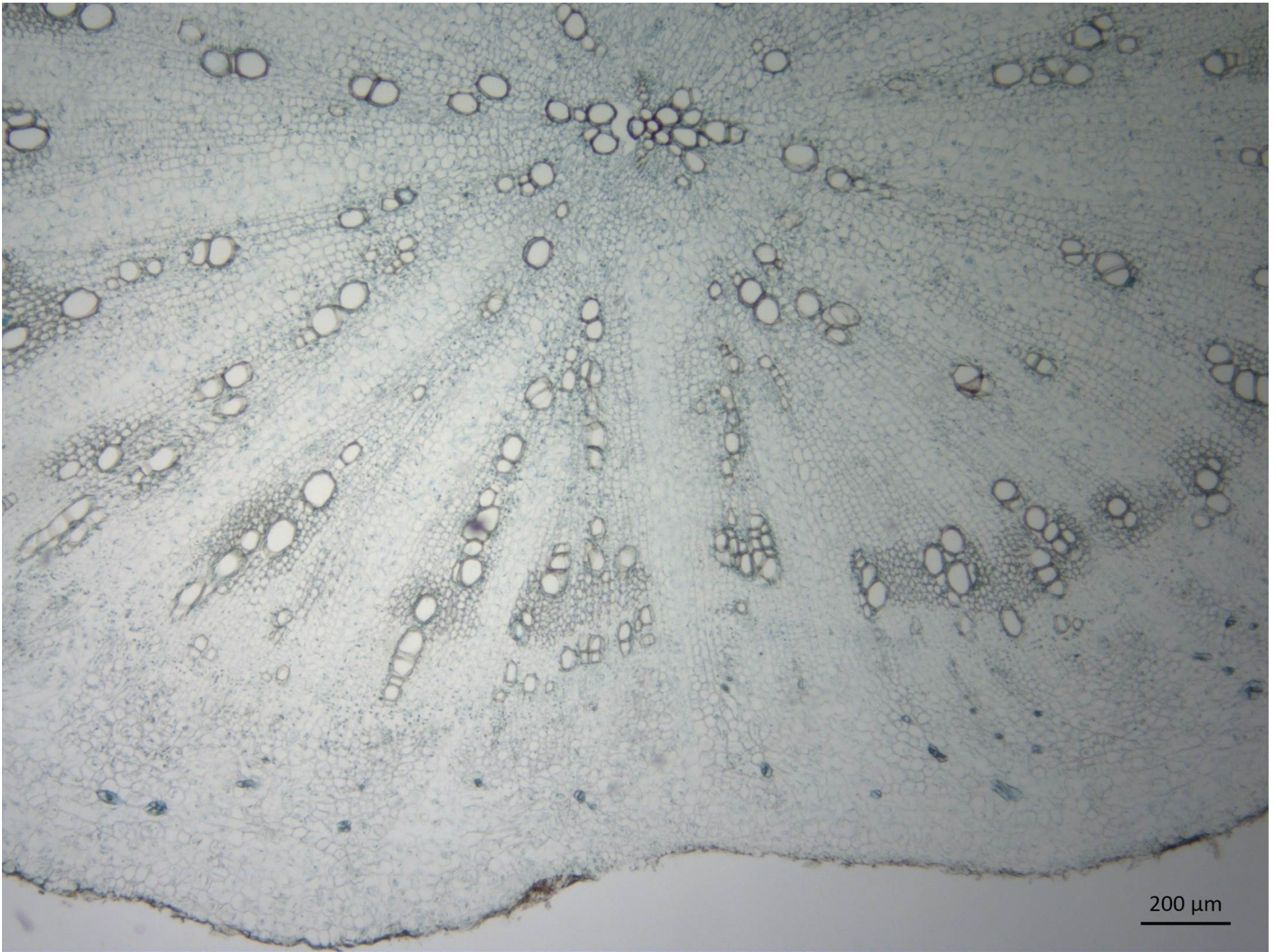
Task 5. The structure of modified roots (rootlets).



Cross-sections of rootstocks with different types of cambium and storage deposition: A - monocambial phloem (carrot); B - bonocambial xylem (radish); C - polycambial (beet). 1 - periderm, 2 - secondary phloem, 3 - cambium, 4 - secondary xylem, 5 - primary xylem.

Cross-section of radish root

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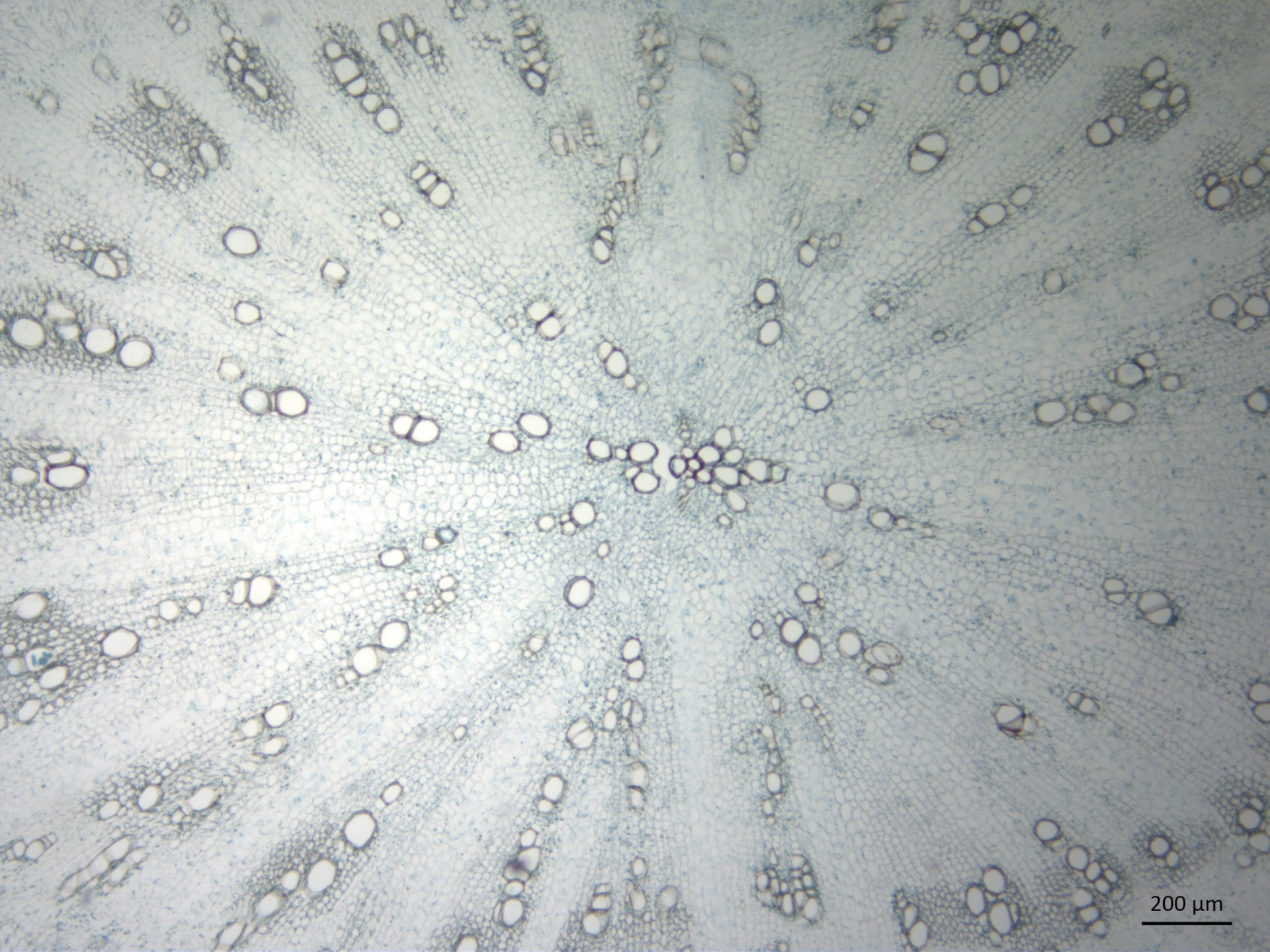
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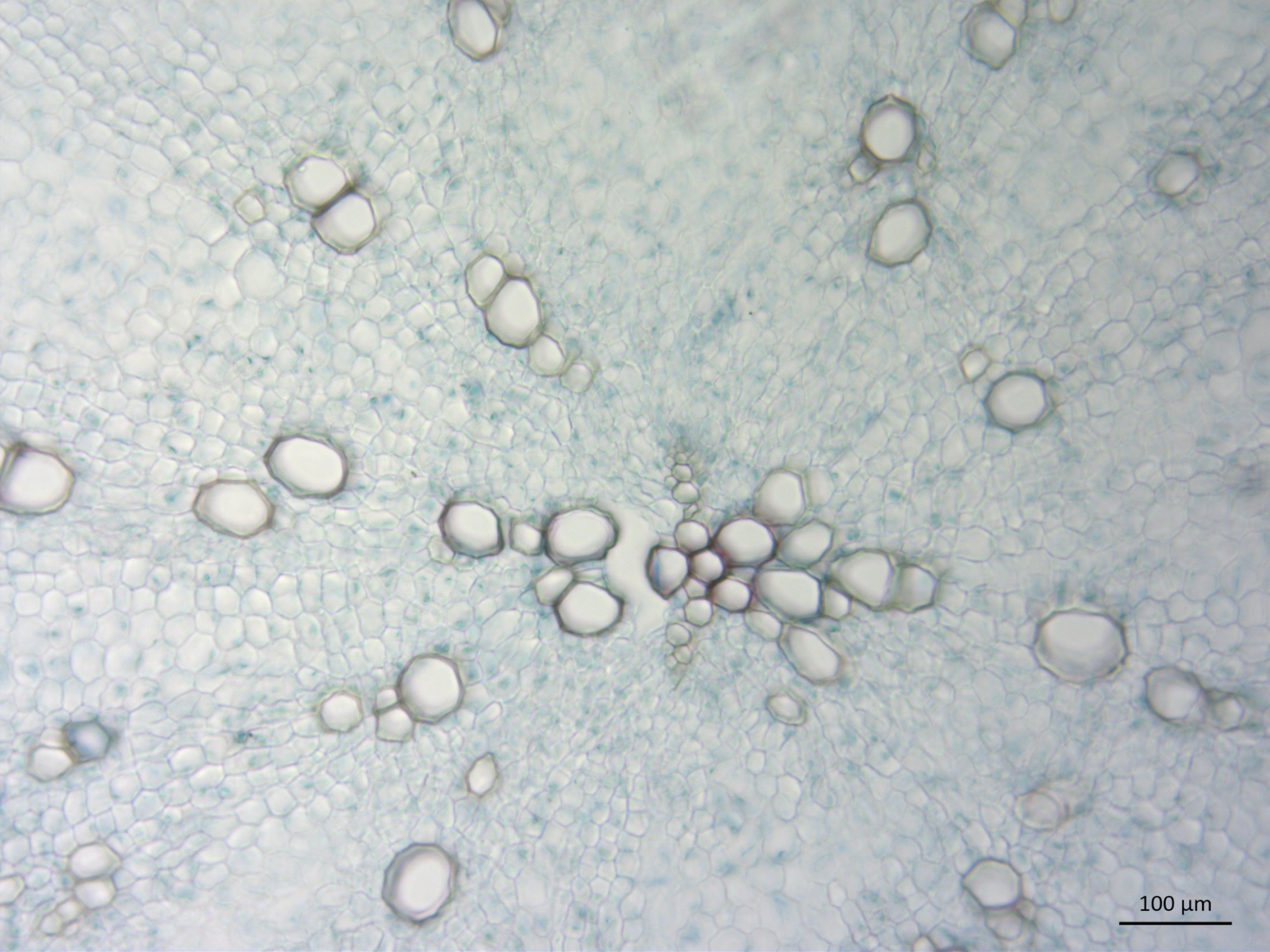
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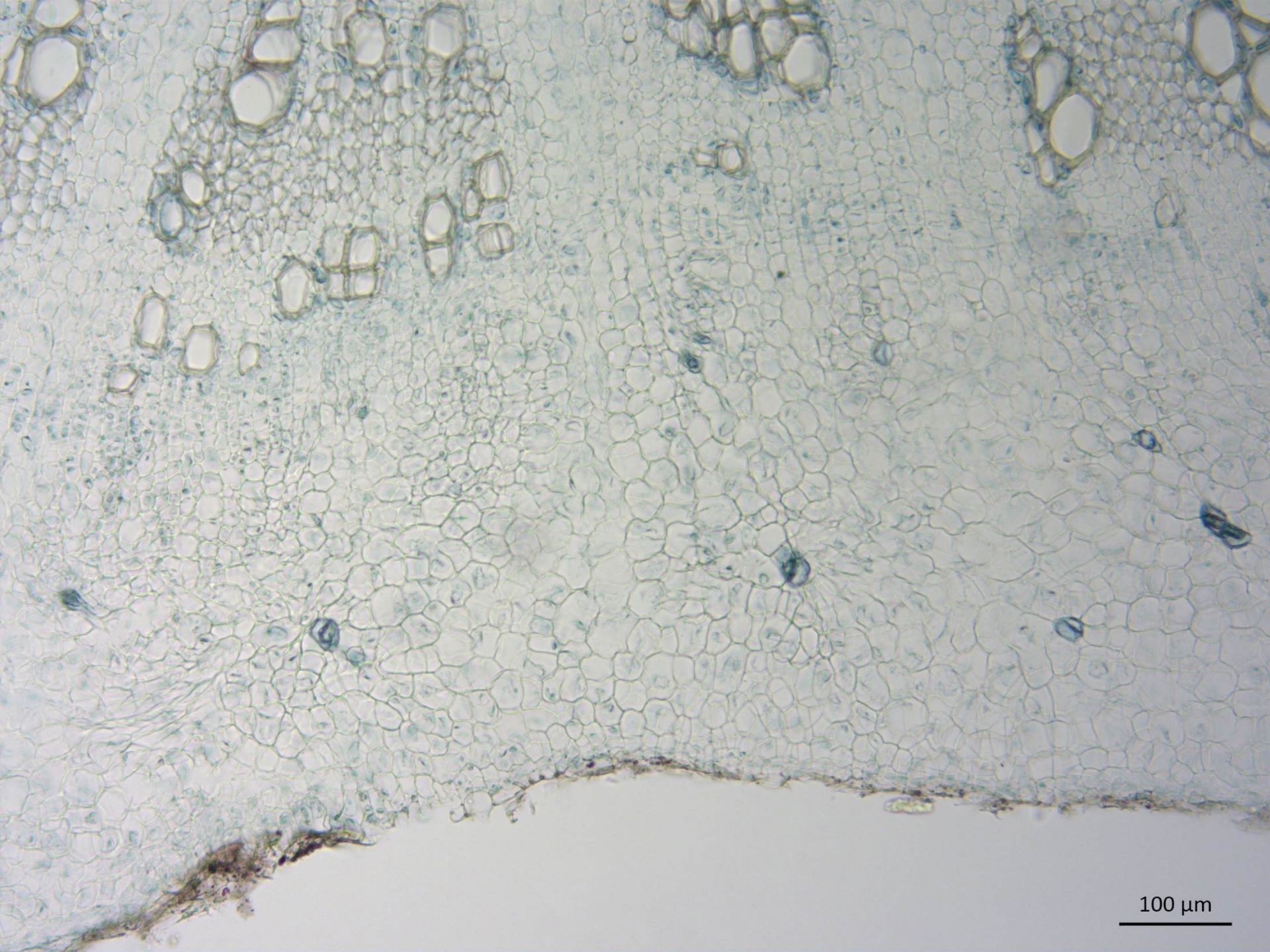
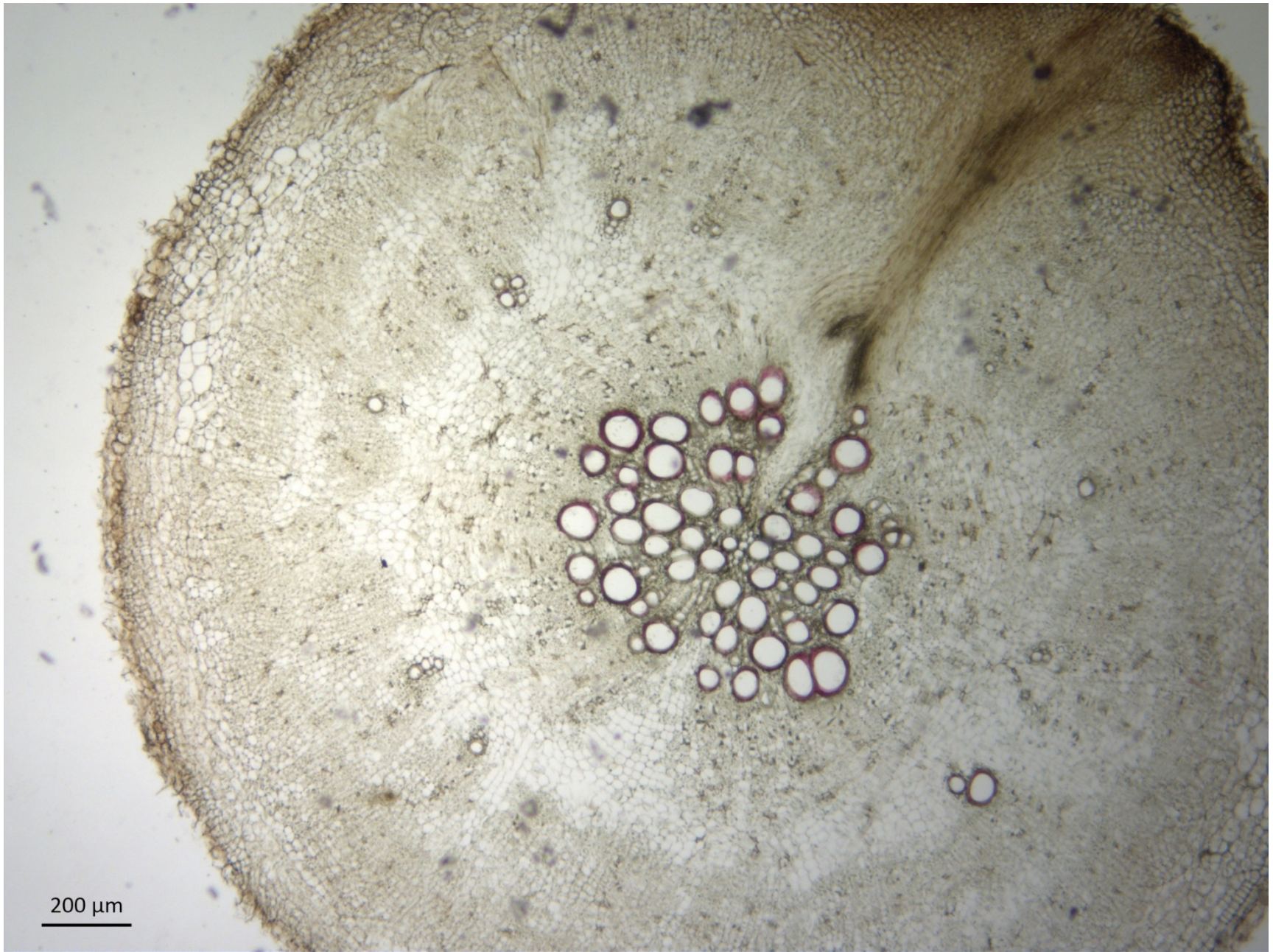
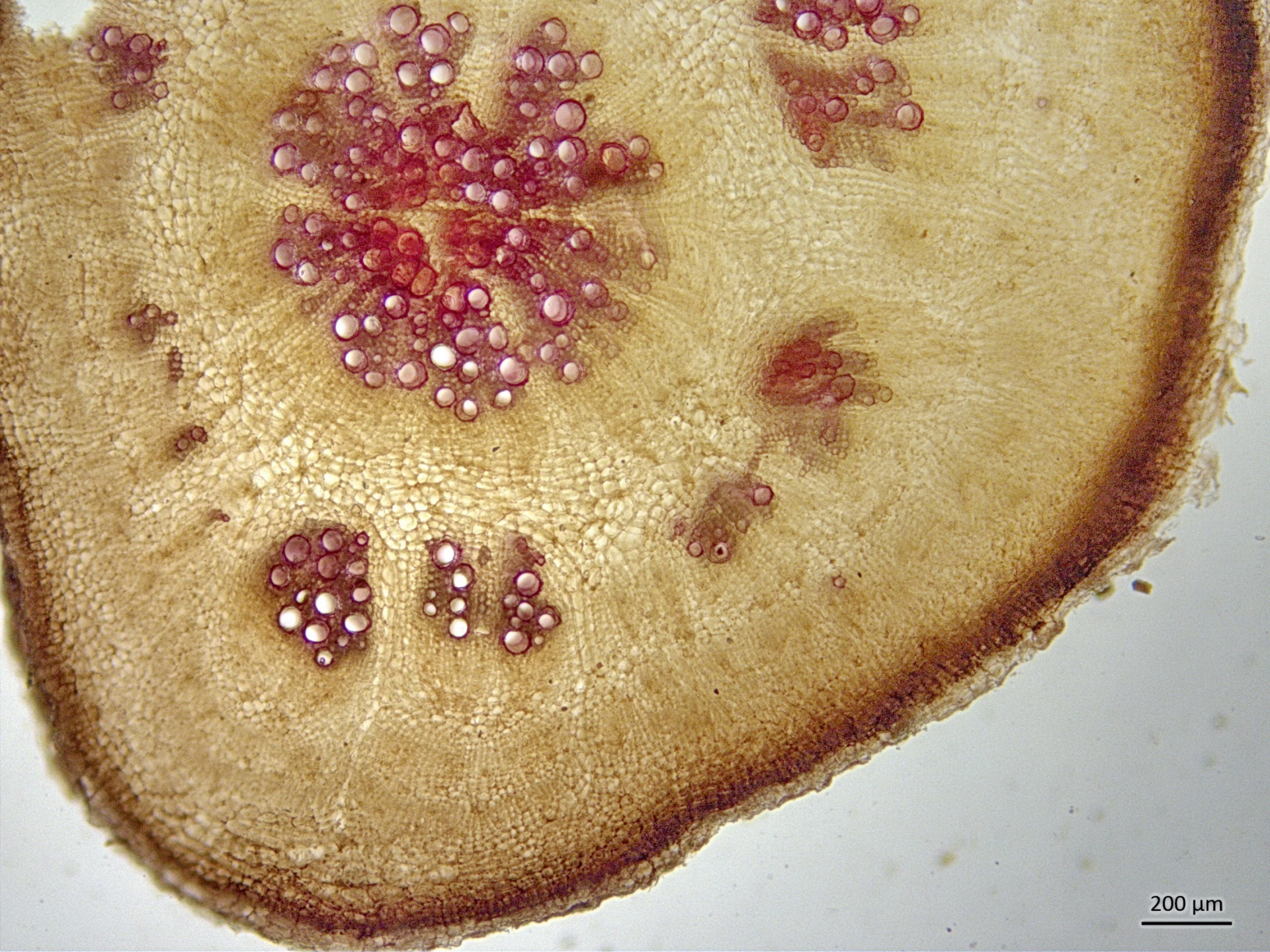

100 µm

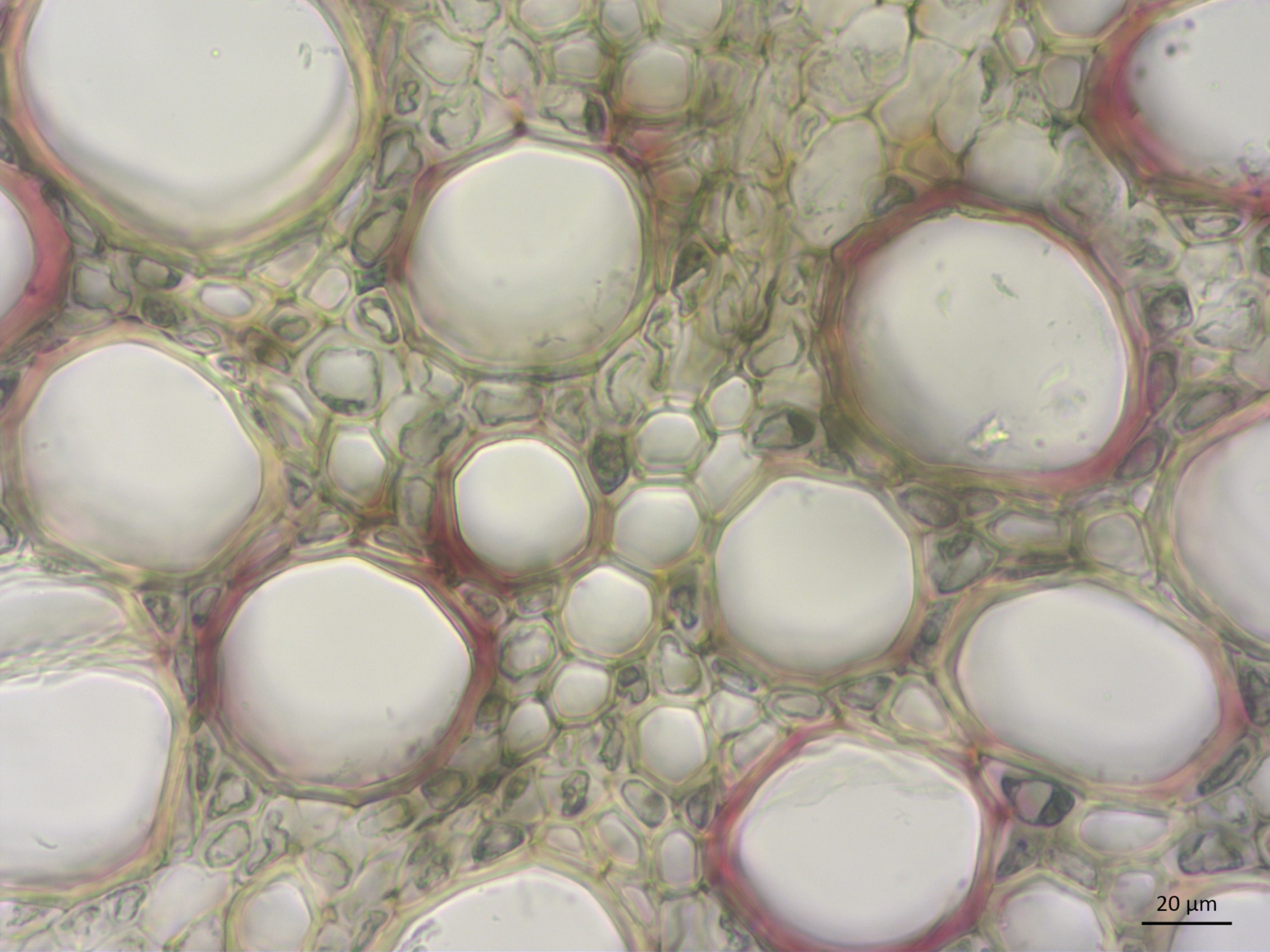
The rings on the cross-section of the beet are formed due to the repeated occurrence of vascular cambium.

Cross section of beet root




200 µm


100 µm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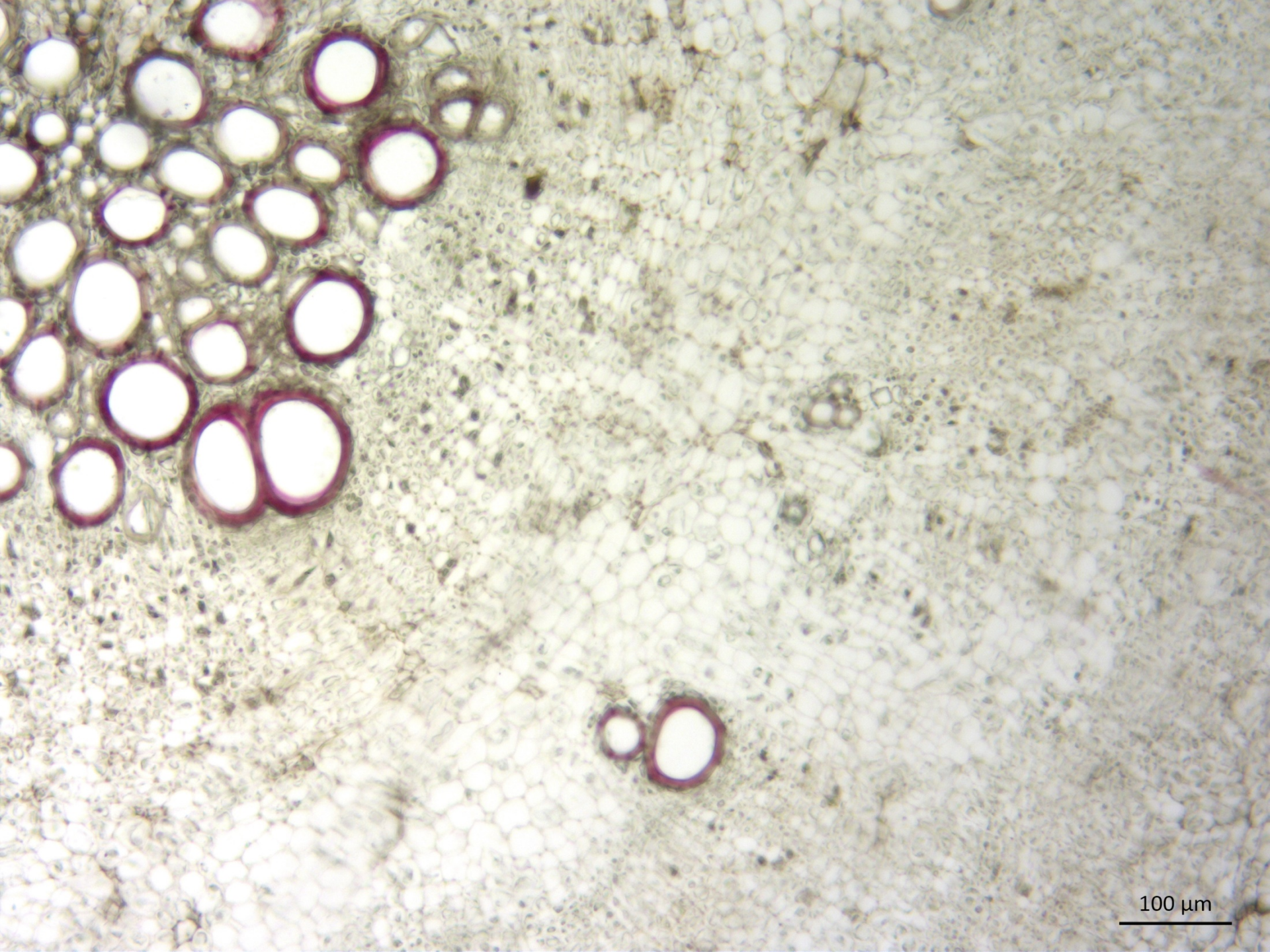
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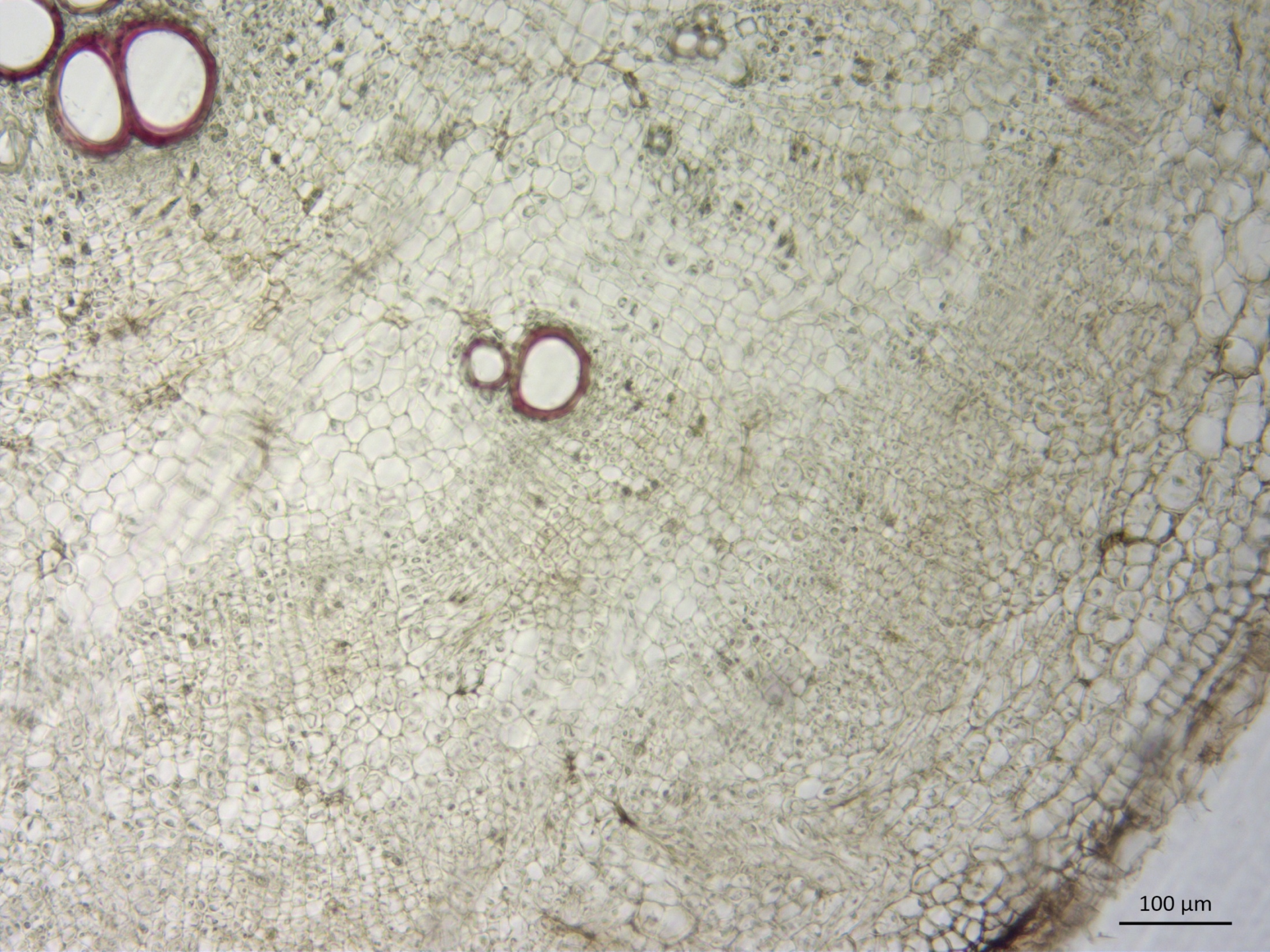
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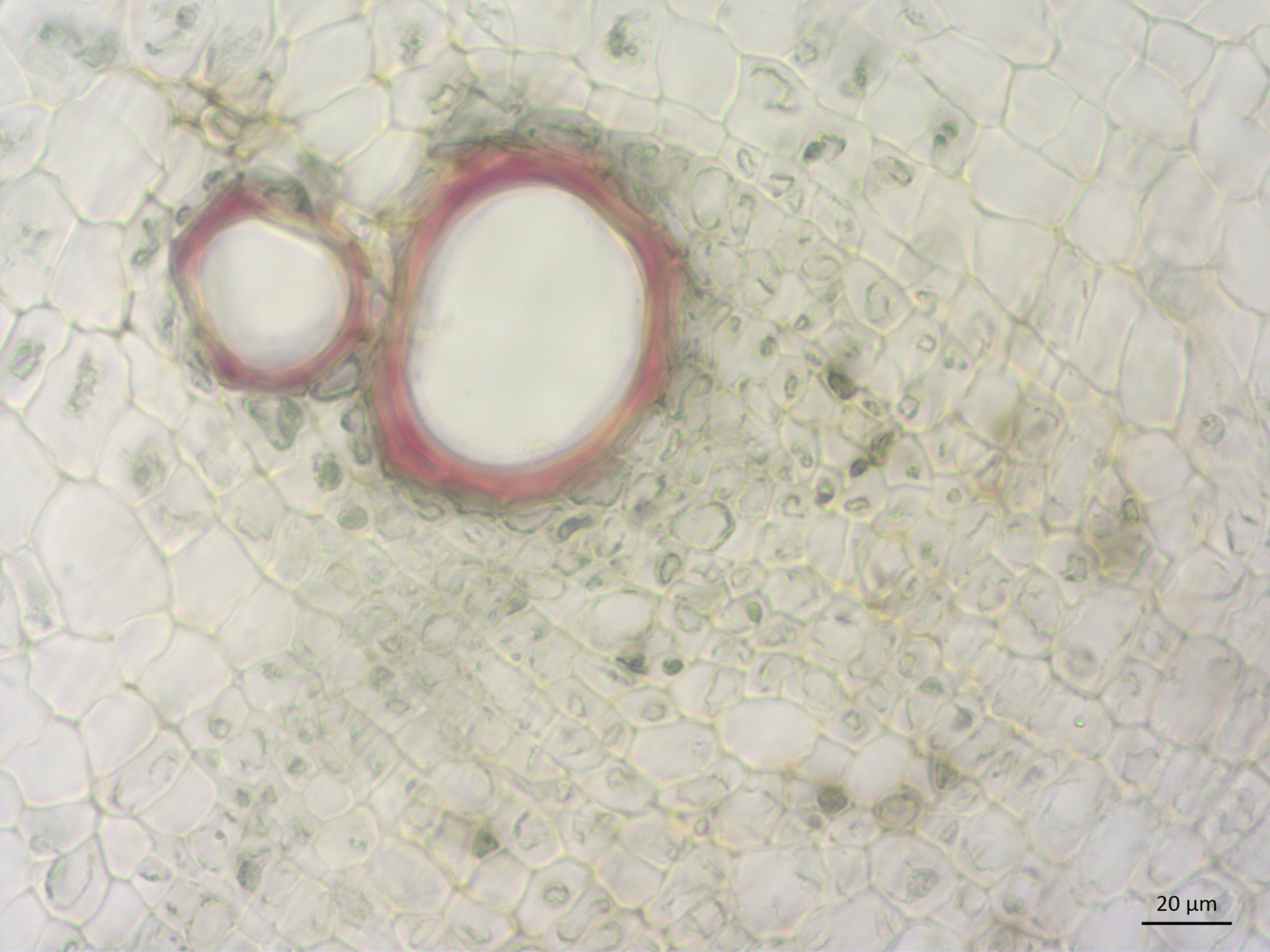
20 µm

Cross-section of carrot root