

# STUDIES ON *LEONTICE LEONTOPETALUM* LINN

## PART III. THE MICROSCOPY OF THE ROOT TUBER OF *L. leontopetalum*

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Samples of the root tuber of *Leontice leontopetalum*, Linn. (Berberidaceae) have been examined histologically. An illustrated description of the distribution of tissues, the cells and cell contents is given.

IN a previous communication<sup>1</sup> the macroscopical characters of the root tuber of *L. leontopetalum*, in the fresh and dried condition, have been described. In this paper the detailed histological structure of the dried tuber is described and illustrated, reference being made to preparations of the fresh tuber in order to elucidate the formation of the lignified parenchyma which forms protuberances on the surface.

### EXPERIMENTAL

*Materials.* The materials used consisted of samples sent by Dr. W. M. Ford-Robertson of the Lebanon Hospital for Mental and Nervous Disorders, Asfuriyeh, Beirut, and of specimens collected by one of us (P.F.N.) in Lebanon.

Sections of dormant tubers were examined and a line drawing made to show the distribution of tissues as seen in cross section (Fig. 1). Detailed drawings to show the microscopical characters of tissues seen in the whole and powdered drug were made (Figs. 2, 4-7). To determine the structure of the numerous protuberances, each of which develops at the base of a fine rootlet in the growing tuber, serial sections from a fresh tuber were cut through a protuberance and the base of its attached rootlet. The structure at the central part of the protuberance is illustrated (Fig. 3).

### *Histology of the root tuber of L. leontopetalum*

EXTERNAL LAYERS (Figs. 2, 3). The thick outer layer consists of 1 to 6 bands of lignified, suberised cork cells alternating with bands of phellogen. Each layer of cork consists of 2 to 8 rows of regular tangentially elongated cells which are polygonal in surface view with straight anticlinal walls. The outermost layer is often crushed and distorted appearing in section as a granular, brown mass with the lumens of some of the cork cells visible as irregular cavities. In surface view the cork cells are 38-130-230  $\mu$  long and 24-70-136  $\mu$  wide; in section, 12-33-62  $\mu$  deep.\* The layers of phellogen consist of 2 to 6 rows of cells similar

\* Because of the irregular shape of the tuber and the ramification of the vascular tissue in every direction, the abbreviations for cell dimensions suggested by Moll and Janssonius<sup>2</sup> could not properly be used.

in shape and size to those of the cork but it is most frequently crushed, making it difficult to distinguish individual cells.

There are frequent protuberances on the surface and it appears that in these regions the innermost layer of phellogen produces parenchyma to the outside instead of cork. Some vascular strands from the inner part

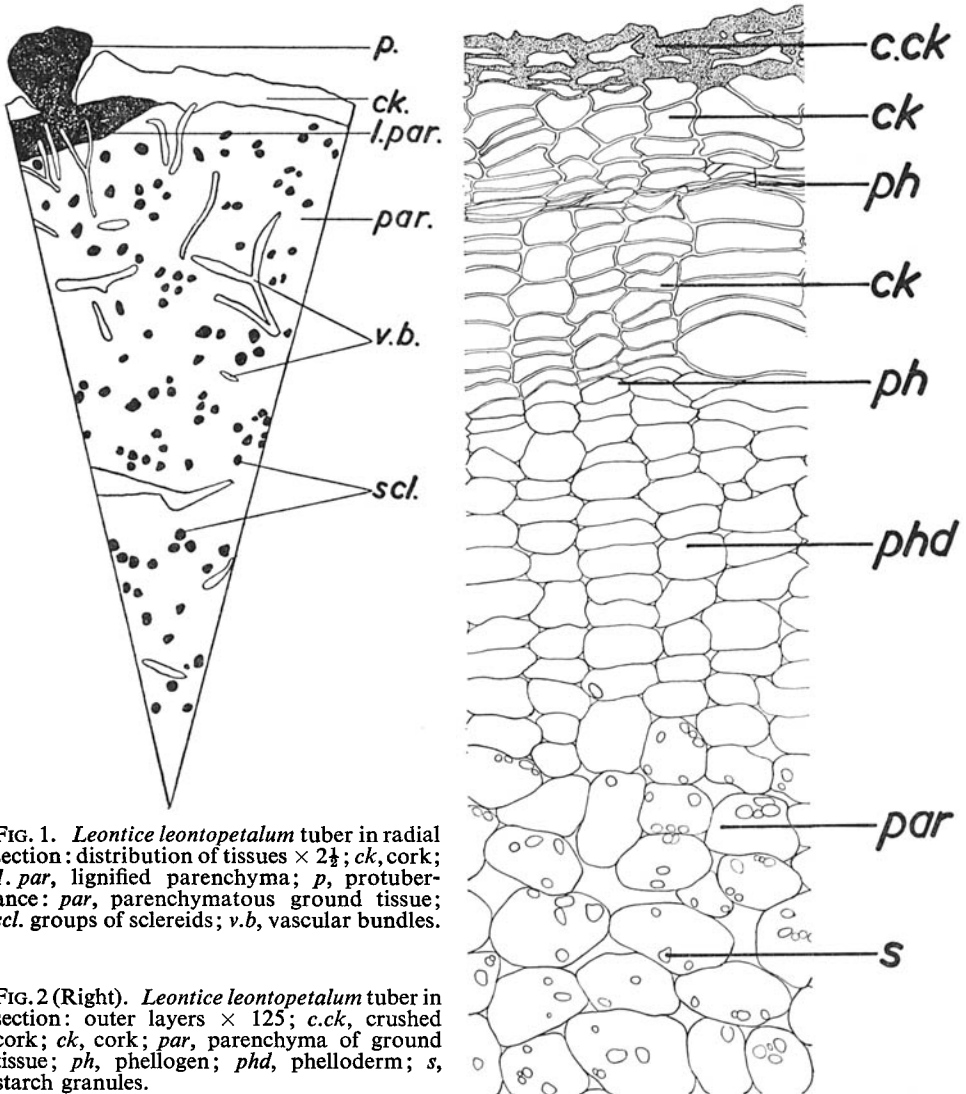


FIG. 1. *Leontice leontopetalum* tuber in radial section: distribution of tissues  $\times 2\frac{1}{2}$ ; *ck*, cork; *l. par*, lignified parenchyma; *p*, protuberance; *par*, parenchymatous ground tissue; *scl*. groups of sclereids; *v. b.*, vascular bundles.

FIG. 2 (Right). *Leontice leontopetalum* tuber in section: outer layers  $\times 125$ ; *c.ck*, crushed cork; *ck*, cork; *par*, parenchyma of ground tissue; *ph*, phellogen; *phd*, phelloderm; *s*, starch granules.

of the tuber join below the phellogen and pass through both it and the externally developing parenchyma into the rootlet which is surrounded at the proximal end by an irregular ring of cork through which the external parenchyma grows to produce the protuberance. The slightly

LEONTICE LEONTOPETALUM LINN. PART III

lacunose parenchyma in the protuberances, which persist when the rootlets die off, becomes lignified and consists of light brown, fairly thin walled cells measuring 34-80-144  $\mu$  long and 18-51-88  $\mu$  broad. Groups of

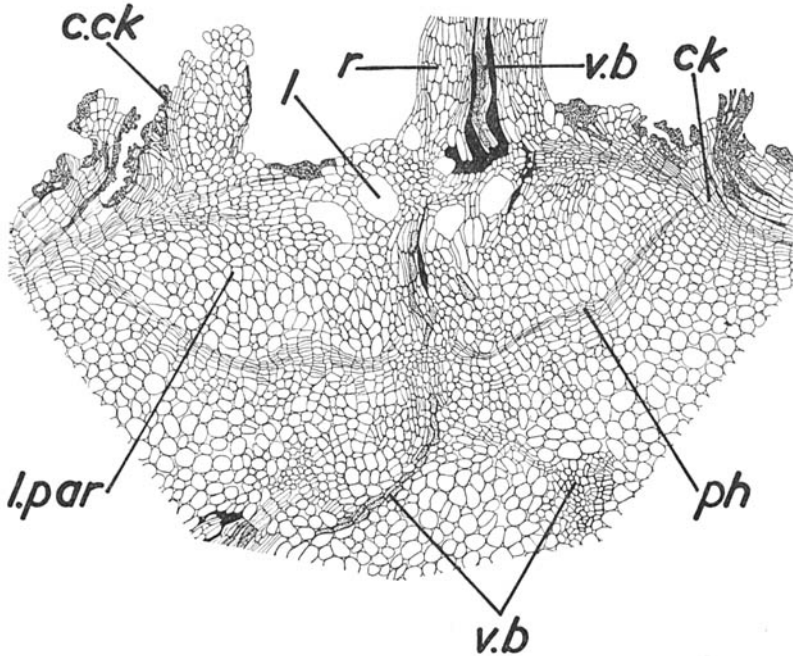


FIG. 3. *Leontice leontopetalum* tuber: radial section through central portion of protuberance and rootlet base  $\times 30$ ; *c.ck*, crushed cork; *ck*, cork; *l*, lacunae; *l.par*, lignified parenchyma; *ph*, phellogen; *r*, rootlet base; *v.b*, vascular bundles.

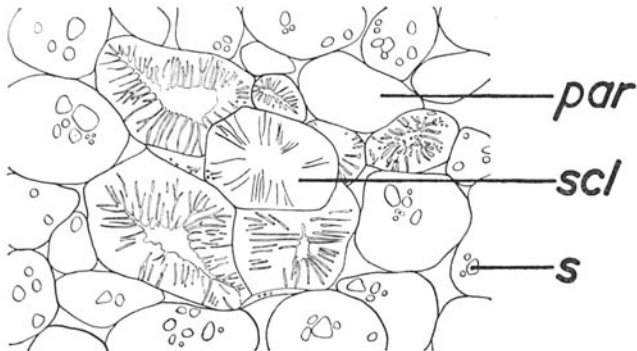


FIG. 4. *Leontice leontopetalum* tuber in section: sclereid group in parenchymatous ground tissue  $\times 125$ ; *par*, parenchyma of ground tissue; *s*, starch granules; *scl*, sclereids.

similar lignified cells are occasionally found internal to the innermost layer of cork.

CORTEX AND STELE. Next to the innermost layer of phellogen is a phelloderm (Fig. 2) which consists of up to 10 rows of cellulosic parenchyma, the cells of which are devoid of starch and are 32–86–158  $\mu$

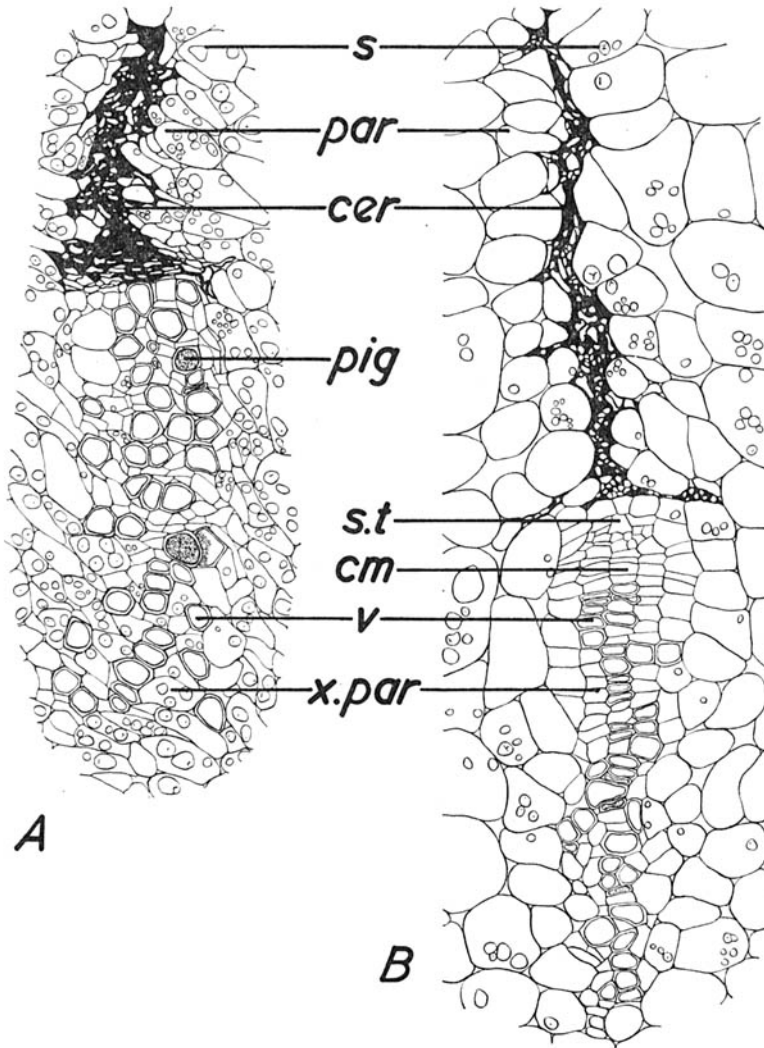


FIG. 5. *Leontice leontopetalum* tuber in section: vascular bundles cut transversely  $\times 125$ : *A*, with xylem parenchyma and vessels irregularly disposed; *B*, with xylem parenchyma and vessels in regular rows; *cer*, ceratenchyma; *cm*, cambium; *par*, parenchyma of ground tissue; *pig*, dark brown pigment; *s*, starch granules; *s.t.* sieve tissue; *v*, vessels; *x.par*, xylem parenchyma.

long and 12–31–62  $\mu$  deep. The remainder of the tuber consists of ground tissue in which there are groups of sclereids and numerous vascular bundles. The ground tissue consists of rounded to slightly elongated

parenchymatous cells containing abundant starch. The cells are 32–102–184  $\mu$  long and 30–70–120  $\mu$  broad. The starch consists mainly of simple granules with very occasional compound granules of 2 to 3 components. The individual granules are rounded to irregularly ovoid in shape, 6–24–63  $\mu$  long and 6–20–49  $\mu$  broad, some having small tuberosities and some being truncate on one side. Striations are absent and the hilum, which is not always visible, consists of a point, split, or occasionally



FIG. 6. *Leontice leontopetalum* tuber in section: vascular bundle cut longitudinally  $\times 125$ ; *cer*, ceratenchyma; *cm*, cambium; *par*, parenchyma of ground tissue; *pig*, dark brown pigment; *s*, starch granules; *v*, vessel; *x. par*, xylem parenchyma.

a 2–5 rayed cleft, sometimes central but more frequently somewhat eccentric. Scattered throughout the ground tissue are irregular groups of large, yellow sclereids, the groups varying considerably in size, being up to 9 cells in diameter (Fig. 4). The individual sclereids may be isodiametric or elongated with a length 92–168–383  $\mu$ , breadth 46–106–183  $\mu$ , and wall thickness 21–41–67  $\mu$ . The walls are heavily lignified and deeply pitted, the pits being simple or branched, appearing as circular pores in surface view; the walls shows striations only after

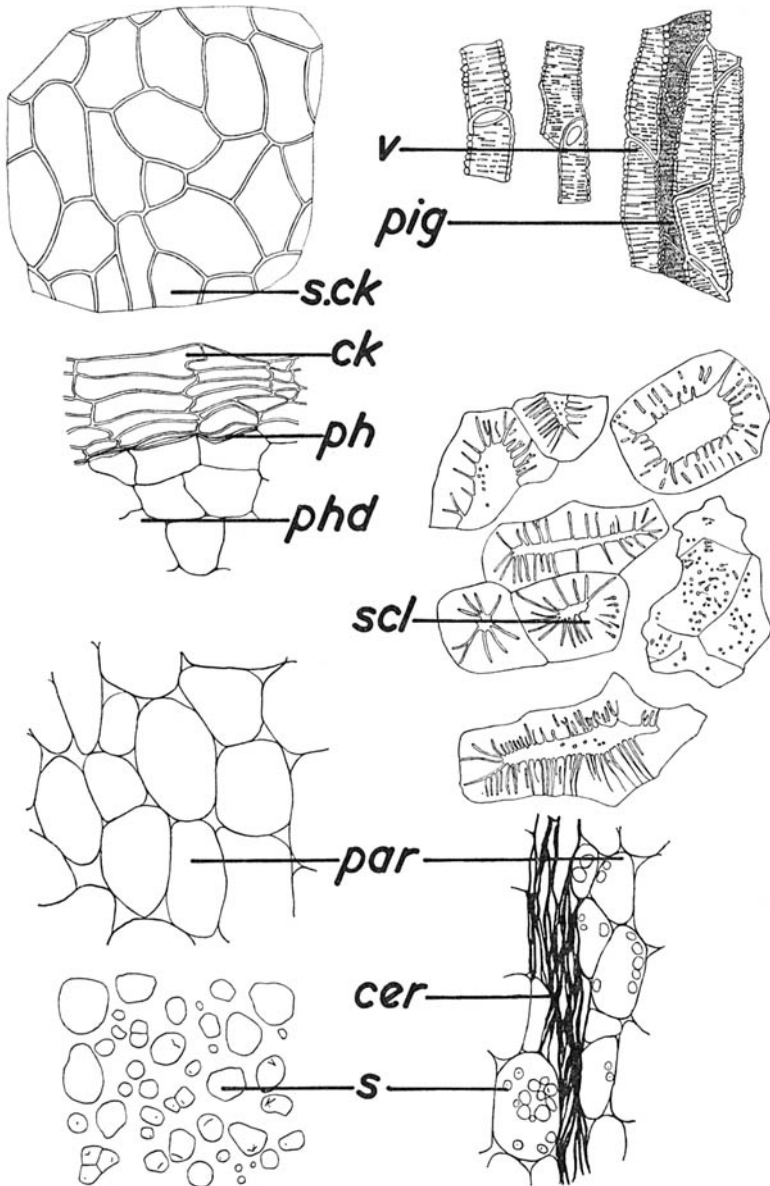


FIG. 7. *Leontice leontopetalum* tuber in No. 60 powder: all  $\times 125$ ; *cer*, ceratenchyma; *ck*, cork; *par*, parenchyma of ground tissue; *ph*, phellogen; *phd*, phelloderm; *pig*, dark brown pigment; *s*, starch granules; *s.ck*, cork in surface view; *scl*, sclereids; *v*, vessels.

prolonged heating with potassium hydroxide solution. The lumen is usually large but occasionally appears as a mere line.

The collateral vascular bundles (Figs. 5, 6) ramify throughout the tuber and in any section it is possible to find bundles cut transversely, longitudinally or obliquely. The phloem consists of a mass of ceratenchyma in which it is seldom possible to differentiate individual cells. The cambium in the bundles is usually not discernible but sometimes 2 to 9 rows of flattened tabular parenchymatous cells, 12–29–98  $\mu$  by 2–13–68  $\mu$ , are seen; in longitudinal view the cambial cells measure 30–91–190  $\mu$ . The xylem consists of parenchyma and vessels which in transverse section are sometimes irregularly disposed (Fig. 5A) but are usually arranged in regular rows (Fig. 5B). The cells of the parenchyma, which often contain starch, are thin walled and elongated along the axis of the bundle; in transverse view the cells are 16–35–74  $\mu$  long by 4–19–58  $\mu$  broad and in longitudinal view the cells measure 50–129–268  $\mu$ . The vessels consist of short tracheid-like segments 60–141–262  $\mu$  long by 10–27–64  $\mu$  wide and each segment has a circular to oval pore at each end. The walls are slightly lignified and irregularly pitted giving a reticulate appearance. A few of the vessels are filled with dark brown material which appears as branching strands running from one vessel to another.

POWDER (Fig. 7). The yellowish-brown powder has a pleasant odour but has a sternutatory effect and a bitter taste.

A number 60 powder was found to have the following microscopical characters, the details of which have been described above:

1. Brown cork in surface view and in section. In section the lignified cork is sometimes seen alternating with bands of phellogen; cells of the phelloderm may also be attached.
2. Small groups of light brown lignified parenchyma.
3. Small groups of large cellulosic parenchymatous cells, many of which contain starch granules, some of which also occur loose.
4. Large, yellow sclereids singly or in small groups.
5. Slightly lignified vessel-segments occurring singly or in groups. The majority are yellowish but some contain a dark brown material.
6. Small, flat area of colourless ceratenchyma.

#### REFERENCES

1. Nelson and Fish, *J. Pharm. Pharmacol.*, 1956, **8**, 1134.
2. Moll and Janssonius, *Botanical Pen Portraits*, Nijhoff, The Hague, 1923, p. 21.