

## STUDIES ON *LEONTICE LEONTOPETALUM* LINN.

### PART II. HISTORY, SOURCES AND MACROSCOPICAL CHARACTERS OF THE PLANT *L. leontopetalum*

BY P. F. NELSON AND F. FISH

*From the School of Pharmacy, The Royal College of Science and Technology, Glasgow*

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In a previous communication<sup>1</sup> attention was drawn to the use in the Middle East of *Leontice leontopetalum* Linn. (Berberidaceae) as a drug and a report of the chemical constituents of the dried root and their pharmacological action was given. A number of inadequate descriptions of the plant, or parts of the plant, appear in the literature, particularly in older works<sup>2-15</sup>, but there is no complete accurate description of the entire plant. The present communication gives a detailed description of the macroscopical appearance of the plant, illustrated by means of photographs and line drawings. Brief notes on the history of the drug, and the geographical distribution of the plant are given. The materials used consisted of samples given by Dr. W. M. Ford-Robertson and his colleagues in 1951, 1952 and 1953 and of specimens collected by one of us (P. F. N.) in Lebanon in 1954.

#### HISTORY

In his work *The Greek Herbal of Dioscorides*, Gunther<sup>16</sup> mentions two drugs, Leontopetalon and Chrusogonon. The former is there identified as *Leontice chrysogonum* and the latter as *L. leontopetalum*, but this latter identification cannot be definite since the inner part of the root of Chrusogonon is said to be strongly red, whereas that of genuine *L. leontopetalum* is yellow. Lovell<sup>17</sup> in his *Compleat Herball* of 1665 makes similar mention of these plants. Linnaeus<sup>2,3</sup> and Jussieu<sup>4</sup> gave brief descriptions of the plant *L. leontopetalum* and it was further described by various later authors<sup>5-15</sup>, of whom Loudon<sup>5</sup> mentions its introduction into Britain in 1597. It has been used as a soap substitute<sup>11,18,19</sup>, a snakebite antidote<sup>11</sup>, a corrective for overdoses of opium<sup>18</sup> and as a remedy for epilepsy<sup>11,13,15</sup>. As indicated in a previous communication<sup>1</sup> the present study was commenced as a result of the current use of the root in the Middle East as a native remedy for the treatment of epilepsy.

#### GEOGRAPHICAL DISTRIBUTION

The plant has been reported to inhabit an area including those countries bordering the eastern part of the Mediterranean<sup>5</sup> from Italy<sup>3,7,15</sup>, Greece<sup>3,7</sup> and Turkey<sup>3,6,7,15,18</sup>, through Lebanon<sup>13</sup>, Syria<sup>7,11,13</sup>, Israel<sup>7,11,13</sup>, Jordan<sup>13</sup> and Iraq<sup>7</sup> to north-eastern parts of Egypt<sup>13</sup>. It has also been seen on the island of Cyprus<sup>7,20</sup>.

All the specimens which we have studied were collected in the Bekaa Plain in Lebanon, although in a brief visit to Syria the plant was also

observed growing in a pass through the Anti-Lebanon Mountains. The Bekaa Plain lies at an altitude of 500 to 1000 metres between the Lebanon and Anti-Lebanon mountain ranges; it is about 12 kilometres from west to east and some 48 kilometres from north to south. The plant was found to grow abundantly in wheat fields at an altitude above 650 metres and specimens were observed growing in fields on the sides of the surrounding mountains up to 1050 metres. Post<sup>13</sup> reported that it was to be found near Sidon which is at sea level, but none was observed by us in this area. However, it was reported that in Cyprus it had been seen growing at about sea level<sup>20</sup>.

Extremes of climate are experienced in the Bekaa Plain, the fields being under snow for much of the winter while the summer is very hot with little or no rainfall. The land is extensively cultivated both in the heavy red loam which is found in most areas and in the denser clay which also occurs. According to the local farmers, the plant will not grow in fields where water lies for any length of time. There were many other fields where the plant did not grow, but all of these appeared to have a shallow top soil and to be very stony, whereas the swollen roots usually grow at a depth of 20 to 30 cm.<sup>13</sup> The majority of plants in any particular field were found to be roughly at the same stage of development, although sometimes both flowering and fruiting plants were observed growing side by side. In addition a few plants bearing leaves only were found. It was observed that the plants growing at lower altitudes were more advanced, presumably because of the somewhat higher temperature.

#### MACROSCOPICAL CHARACTERS

The plant is a perennial herb with large compound leaves, a compound inflorescence of yellow flowers and a large intercalary root tuber. The inflorescence grows to a height of about 29 to 45 cm. while the foliage leaves usually lie close to the surface of the ground both in plants with, and without an inflorescence.

*Inflorescence.* (Figs. 1, 2, 3.) The compound inflorescence is a panicle composed of about 8 to 18 racemes. The mature panicle has a maximum diameter of about 22 to 28 cm. and occupies about one-half of the total height of the aerial part of the plant. The lateral racemes arise from the axils of small foliage leaves which vary greatly in shape and size and have a phyllotaxis of 3/8. The lateral racemes vary considerably in length on any one plant, becoming smaller towards the apex of the inflorescence and they also bear varying numbers of flowers. A typical plant examined had 17 lateral racemes varying in length from 7 to 18 cm. each bearing between 9 and 30 flowers. The apical raceme also varies from plant to plant, and as a rule bears more flowers than any of the lateral racemes, usually from about 28 to 48.

*Stem.* (Fig. 4.) The upright stem is cylindrical in shape and about 0.6 to 1.2 cm. in diameter, the underground portion being white to very pale green in colour, while the aerial stem is pale green with a purplish zone at ground level. The surface of the stem has very faint longitudinal striations. The cut transverse surface of the stem shows a thin

epidermis, a narrow cortex and a zone of lignified pericycle surrounding a large central area containing several irregular rings of collateral vascular bundles, which lie more or less radially and surround a central pith. Each of the inner vascular bundles has a separate well defined pericycle, and here, as in the outer zone of pericycle, very large spaces occur. In

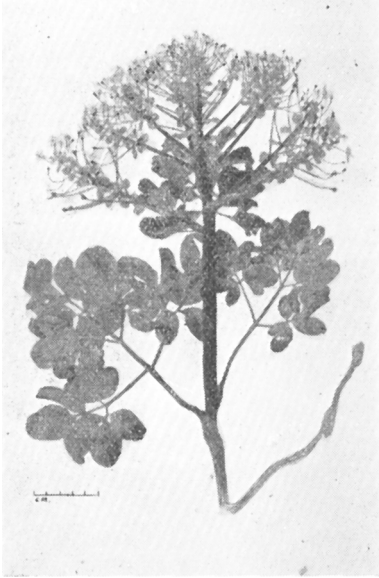


FIG. 1. *Leontice leontopetalum* flowering top (pressed specimen)  $\times 1/6$ .



FIG. 2. *Leontice leontopetalum* fruiting top (fresh specimen)  $\times 1/6$ .

longitudinal section these appear as wide tubes. The pith may become slightly lignified, and according to Solerec<sup>10</sup> it retracts in older stems to leave a central cavity.

*Leaves.* (Fig. 3, E & F.) The leaves may be conveniently divided into types, large and small, the latter being those leaves which subtend the racemes.

Most plants have two to four large leaves, but sometimes five or six such leaves are found. Several of these usually arise around the base of the stem, the remainder arising just below or above ground level. The leaf is biternatisect, often triternatisect and sometimes showing an even greater degree of dissection in the apical group of leaflets, especially in those arising at the base of the stem. The leaves are about 12 to 60 cm. long by 9 to 25 cm. broad and the leaflets are about 1.5 to 8 cm. long by 0.8 to 4.2 cm. broad. The long, stout rachis is somewhat flattened dorsiventrally and is vaginate at the base, the sheath bearing well marked longitudinal striations. Most of the leaflets are asymmetrical and vary from ovate to oval to obovate and are occasionally subcordate. The apex of the leaflet is often somewhat recurved and is usually retuse with a small mucronate projection of the lamina at the end of the main vein.

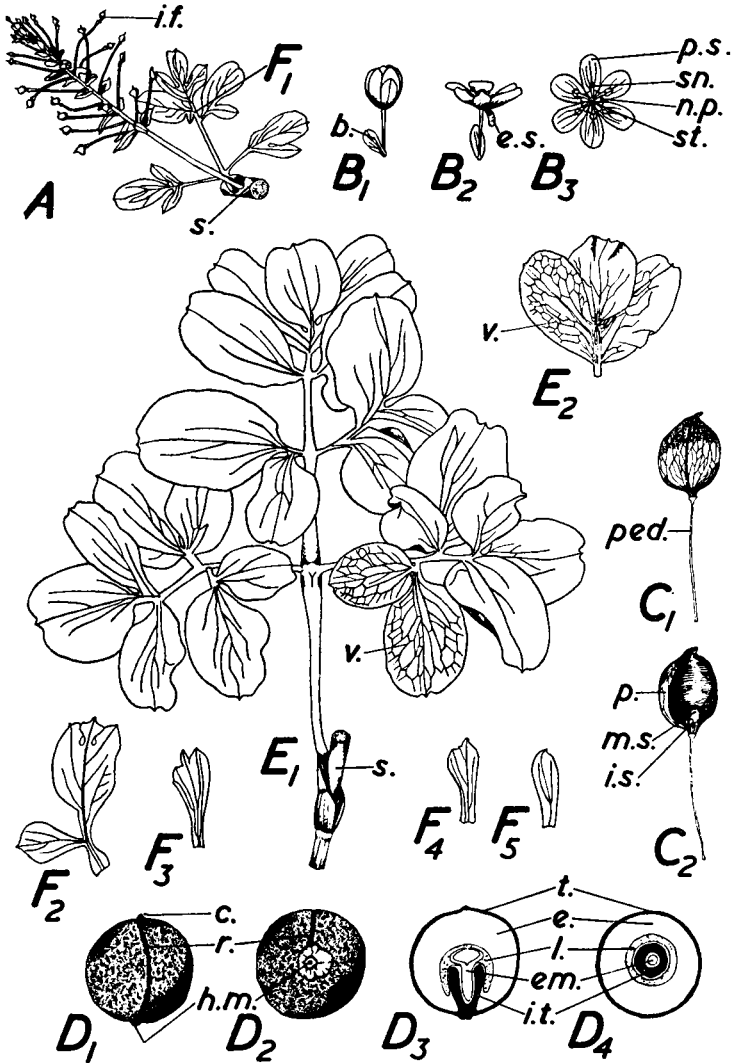
*Leontice leontopetalum*

FIG. 3. *Leontice leontopetalum* aerial parts:—A, lateral raceme  $\times \frac{1}{2}$ ; B, flower  $\times \frac{1}{2}$ : 1, unexpanded, 2, expanded, side view, 3, expanded, from above; C, fruit  $\times \frac{1}{2}$ : 1, entire, 2, with part of pericarp removed; D, seed  $\times 2$ : 1, entire, side view, 2, entire, from below, 3, longitudinal section, 4, transverse section through lower third; E, large foliage leaf  $\times \frac{1}{2}$ : 1, entire, upper surface, 2, apical leaflets, under surface; F, small foliage leaves  $\times \frac{1}{2}$ : 1–5, series showing variation in degree of dissection.

*b.*, bract; *c.*, chalaza; *e.*, endosperm; *em.*, embryo; *e.s.*, extra sepal; *h.m.*, hilum and micropyle; *i.f.*, immature fruit; *i.s.*, immature seed; *i.t.*, infolding of testa; *l.*, lacunose region of endosperm; *m.s.*, mature seed; *n.p.*, nectariform petal; *p.*, pericarp; *ped.*, pedicel; *p.s.*, petaloid sepal; *r.*, raphe in shallow groove; *s.*, stem; *sn.*, stamen; *st.*, stigma; *t.*, testa; *v.*, detailed venation.

The margin of the leaflet is usually entire but may bear one or two small indentations. The leaflets are sessile on the branches of the rachis and the lamina is asymmetrical at the base. The venation is pinnate but sometimes there is a vein lying parallel to the midrib without apparently joining it at the base. The lateral veins leave the midrib at an acute angle and often anastomose close to it; there are many smaller veinlets forming a network, those towards the outside anastomosing about 2 to 3 mm. from the margin. The main veins are slightly depressed on the upper surface and raised on the under surface. Both surfaces of the leaflets are smooth, of a somewhat waxy texture and bluish-green colour. If any part of the rachis lies below the ground it is usually white to pale green in colour with a purplish zone at ground level.

The small leaves occur on the upper part of the stem and bear in their axils the racemes which form the leafy panicle. They vary greatly in size, shape and degree of dissection, those nearest the apex of the panicle being smaller and without any dissection. The largest of these leaves, those subtending the first of the racemes, are from about 6.1 to 8.2 cm. long by about 7.0 to 9.3 cm. wide, while the smallest are only about 1.5 to 2.5 cm. long by about 0.3 to 1.2 cm. wide. The largest leaves are ternatisect with the leaflets sometimes further dissected and the degree of dissection decreases in the smaller leaves as illustrated in Figure 3, F 1-5.

*Racemes.* (Fig. 3, A.) The racemes are borne on slender cylindrical stems arising in the axils of the small foliage leaves. These stems bear numerous bracts which are oval, ovate or oblong with a rounded apex, entire margin and a wide sessile base. They are from about 0.4 to 2.8 cm. long by about 0.3 to 0.9 cm. wide. In the axils of these bracts the yellow flowers are borne.

*Flowers.* (Fig. 3, B.) The flowers are borne on green, cylindrical pedicels which widen slightly at the base and at the receptacle. The length of the pedicel varies greatly, increasing as the flower and the fruit develop, becoming up to 6 cm. and more in the mature fruit. The flat receptacle bearing the flowering parts is circular in surface view.

The flowers are hermaphrodite, cyclic and trimerous. According to Bailey<sup>15</sup> flowers of the genus *Leontice* may have 3 to 9 petaloid sepals with 6 petals which are often reduced to nectaries and Bentham and Hooker<sup>6</sup> state that the sepals may be from 6 to 9 and petaloid, the outer being smaller, and the 6 petals are very small and nectariform with a truncated apex. The perianth of *Leontice leontopetalum* consists of six yellow, obovate, petaloid sepals, about 8 to 10 mm. long, arranged in two whorls of three, with a small, yellow nectariform petal attached to the base of each sepal. In addition there is often a smaller seventh sepal to the outside. This extra sepal is about 6 to 7 mm. long, and is yellowish green in colour with a darker green central vein. It lies immediately external to one of the outer whorl of sepals and is often recurled in the open flower. There are six free stamens with filaments which often broaden out below the anther. The ovary is solitary and bulbous with a short curved style and an inconspicuous stigma with a flattened top; it is unilocular containing 2 to 4 ovules attached at the base.

*Fruits.* (Fig. 3, C.) After the fall of the perianth and stamens the fruit develops quickly, the mature fruit consisting of an ovoid bladderly capsule about 4 cm. long by 2.8 cm. in diameter. The thin pericarp dries on ripening, becoming membranaceous, and often becomes completely detached from the pedicel leaving the seed naked. The style persists to

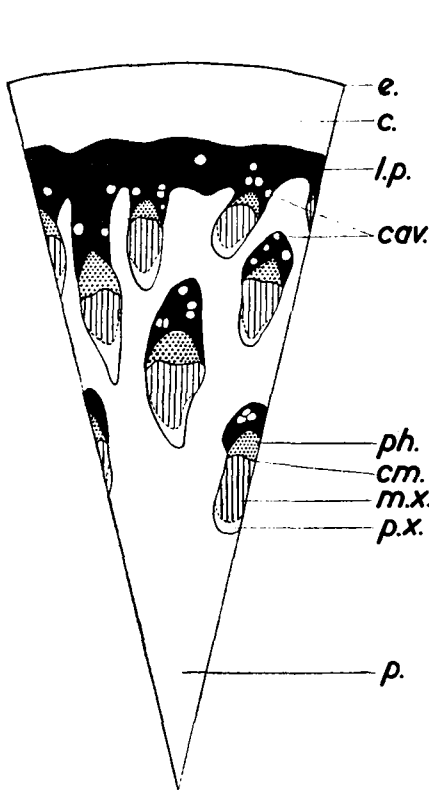


FIG. 4. *Leontice leontopetalum* stem in T.S.  $\times 20$ . *c.*, cortex; *cav.*, cavities in pericycle; *cm.*, cambium; *e.*, epidermis; *l.p.*, lignified pericycle; *m.x.*, metaxylem; *p.x.*, protoxylem; *p.*, pith; *ph.*, phloem.

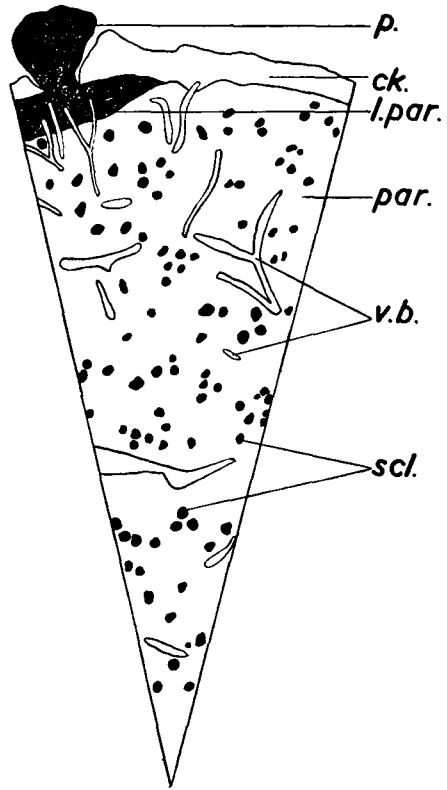


FIG. 5. *Leontice leontopetalum* root tuber in T.S.  $\times 2\frac{1}{2}$ . *ck.*, cork; *l.par.*, lignified parenchyma; *p.*, protuberance; *par.*, parenchyma; *scl.*, groups of sclereids; *v.b.*, vascular bundles.

form an acute projection, often slightly to one side at the apex. The base of the capsule is rounded and joined to the pedicel by a short tube-like extension. On the adaxial side of the pericarp there is one wide vein running longitudinally from base to apex; the remaining veins are much finer and anastomose to form a network over the entire pericarp. The lower part of the capsule is green and the upper part varies from a very light brownish-purple to a fairly deep purple. The fruit usually contains only one ripe seed, with 1 to 3 immature seeds, but occasionally 2 or 3 seeds may develop fully.

*Seeds.* (Fig. 3, D.) The subglobular seed is borne on a short funicle

and is formed from an anatropous ovule. The greatest diameter of the seed varies from about 0.4 to 0.7 cm. The rough testa is of a dark purplish-brown colour with a whitish-violet bloom, especially evident at the base and in the shallow groove in which the raphe occurs. The hilum and micropyle lie in a light brown raised area at the base of the seed and the chalaza occurs as a slight protuberance at the apex. In longitudinal section the seed shows a narrow brown testa with a cup-shaped infolding at the base into the white, proteinous and oily endosperm which is lacunose centrally. The embryo is small with a terete radicle

and two small thick incurved cotyledons. It lies in the lacunose region of the endosperm with the radicle in the cup-shaped infolding of the testa.



FIG. 6. *Leontice leontopetalum* root tuber  $\times 1/3$ .

*Root Tuber.* (Figs. 5, 6.) The tuber varies greatly in size and shape but is usually irregularly circular to oval in outline and somewhat flattened dorsiventrally. The maximum size of tubers of flowering plants is about 23 cm. in diameter by about 10 cm. in thickness, while the smallest tubers from such

plants are about 7 cm. in diameter by about 5 cm. thick. Externally it is covered with a thick brown cork with small protuberances from which fine white rootlets arise. The main stem is attached more or less centrally to the upper side of the tuber and some of the foliage leaves arise around the stem at this point. In the dormant tuber this point is often difficult to determine though it may be seen as a protuberance with some slight remains of the aerial parts. Similarly the position of the rootlets is marked by smaller protuberances in the cork which becomes scaly and exfoliates in places. The cut surface of the fresh tuber is bright creamy-yellow in colour. The cork is thick, lignified and irregular due to the presence of the many protuberances. These are composed of large lignified cells and groups of such cells also occur in some places internal to the cork. The bulk of the tissue is composed of starchy parenchyma with groups of large yellow sclereids and with vascular bundles in transverse, oblique and longitudinal view, scattered throughout. In the growing tuber there is a layer of actively dividing meristematic tissue about 1.5 to 3 cm. internal to the cork, but this layer is not discernible in the dormant tuber.

In Lebanon the tubers are dug up for use as a drug after the aerial parts have died down and only as required for immediate compounding, therefore the drug used is the fresh dormant tuber. Some of the earlier specimens received by us had been partially dried and were considerably attacked by mould during transit, therefore arrangements were made to have the freshly collected tubers washed, cut into slices and dried rapidly in the sun. This proved satisfactory for the prevention of obvious deterioration.

The dried drug, obtained in this way, consists of irregular slices about 0.5 cm. thick. Externally there is a thick brown cork and the remainder

## LEONTICE LEONTOPETALUM LINN. PART II

of the drug is light brown in colour and consists of starchy parenchyma with the vascular bundles appearing as points or striations and the groups of sclereids as protuberances. Often there are dark brown areas lying internal to the cork and these consist of lignified parenchyma. The texture is hard and brittle; the odour is quite pleasant but the freshly fractured drug and the powder are sternutatory; the taste is bitter.

### SUMMARY

1. Notes on the history and geographical distribution of the plant *Leontice leontopetalum* Linn. have been recorded.
2. The macroscopical characters of the entire plant in the flowering and fruiting condition have been described and illustrated.
3. A description of the collection and drying of the root tubers in Lebanon has been given.
4. The macroscopical characters of the dried drug have been described.

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### DISCUSSION

The paper was presented by MR. P. F. NELSON.

DR. T. E. WALLIS (London) said with reference to the structure of the stem, it was typical of Berberidaceae to find the peculiar arrangement of the vascular tissues. It might be mistaken for that of a monocotyledon. As to the question of precise identity of the sclerenchyma associated with the isolated bundles, it seemed a little unlikely that it should be pericyclic. So far as the shape of the leaflets was concerned, he took it that those which were not asymmetrical were terminal ones. There was no definite statement on the number of carpels present in the ovary. The statement was made that the ovary was "solitary" and it was difficult to be certain what that meant; it did not state whether there was one carpel or more.

DR. J. M. ROWSON (London) asked the authors to say a little more about the small protuberances on the root tuber. The emergence of sclerenchymatous matter in the cork was referred to, and when the authors studied the detailed anatomy no doubt they would again reflect on the morphology.

MR. P. F. NELSON, in reply, said on the question of the pericycle, he had consulted some of his botanical colleagues about the matter and they suggested that it was the correct term. The term "solitary" should be "single", with reference to carpel. The symmetry of the leaflets was difficult to determine because they were shrivelled up, and began to shrivel almost as soon as they were picked. The protuberances occurred where the rootlets arose in the following spring when the plant started to grow.