

# THE STRUCTURE OF THE FLOWERS OF *DATURA STRAMONIUM* L. AND *D. TATULA* L.

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*From the Museum of the Pharmaceutical Society of Great Britain*

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## INTRODUCTION

LINNAEUS, in his *Species Plantarum*, first edition<sup>1</sup>, 1753, gives a very brief diagnosis of the plant *D. stramonium* to which are added a few words about the leaves in the second edition, but this does not include any description of the flowers. A description of the gross morphology of the flower appears in *Medicinal Plants*, by Bentley and Trimen,<sup>2</sup> 1880. The histology of the entire plant, including that of the flower, has been studied in considerable detail by Fischer<sup>3</sup> in 1937, but the few drawings and photographs used to illustrate his work are unsatisfactory. It seemed desirable, therefore, to make a fresh examination of the flower and to write a new description of its gross morphology and histology and to illustrate it by adequate drawings.

## MATERIAL

The specimens used for this study were collected from the following sources:

1. Flowers collected from the Chelsea Physic Garden in June, 1947.
2. Three specimens of dried flowers from the Museum of the Pharmaceutical Society of Great Britain, one of them labelled; Mr. Stewart, Glasgow, 1938.
3. Flowers from a commercial sample of the crude drug from Messrs. British Drug Houses, London, purchased, 1949.

## GROSS MORPHOLOGY

The inflorescence is described as a dichasial cyme in which each bract is displaced by adnation to the shoot up to the point where the next branches arise. The flowers are solitary, shortly pedicellate, erect and arising at the fork of the stems.

*Calyx* (Fig. 2A). *Sepals*, forming a pale-green tubular structure, broadening slightly towards the base, with 5 sharply projecting ridges over the midribs; the *tube* measuring about 2 to 3 cm. long; *lobes* acutely triangular and varying somewhat in size, measuring about 10 mm. long;  *aestivation* valvate; calyx fugaceous, the abscission taking place along a circumferential line near the base, leaving a small, saucer-shaped persistent part.

*Corolla* (Fig. 4A). *Petals*, white, delicate and funnel-shaped, the long tubular part being 4 to 5 cm. long and projecting beyond the calyx and then increasing in diameter as it approaches the lobes which are rounded-triangular and spreading, each about 6 to 10 mm. long and having

a thin, acuminate, folded, almost filiform tip; *æstivation* plicate and twisted; corolla fugaceous.

*Andræcium* (Fig. 4A). *Stamens*, the free part of the filaments about 17 to 25 mm. long, the adherent part, which is about 20 to 25 mm. long,

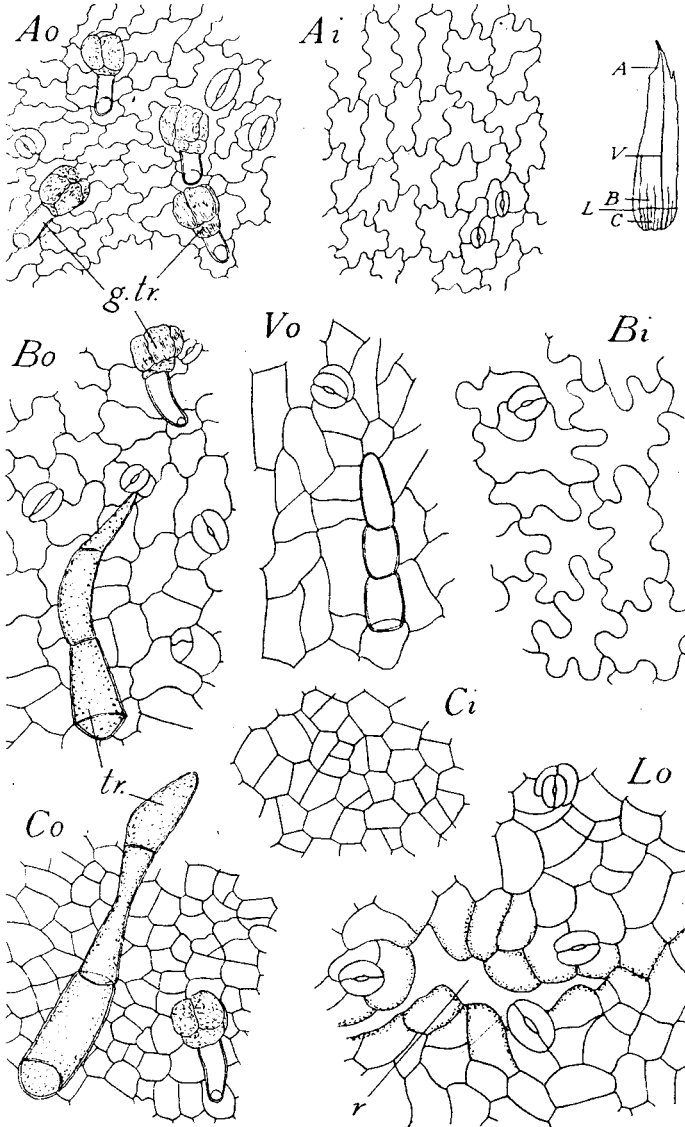


Fig. 1. *Datura stramonium* L., Calyx. Ao, outer epidermis at position A (as marked on diagram of one sepal, top right); Ai, inner epidermis at A; Bo, outer epidermis at B; Vo, outer epidermis over vein at V; Bi, inner epidermis at B; Co, outer epidermis at C; Ci, inner epidermis at C; Lo, outer epidermis at line of abscission at L; *g.tr.*, clavate glandular trichome; *r.*, rupture at line of abscission; *tr.*, warty covering trichome. All  $\times 160$ .

FLOWERS OF *DATURA STRAMONIUM* L. AND *D. TATULA* L.

forming a wide projecting rib on the inner surface of the lower part of the corolla tube. *Anthers*, about 2 to 5 mm. long, basifixed, dehiscence lateral, along two longitudinal splits.

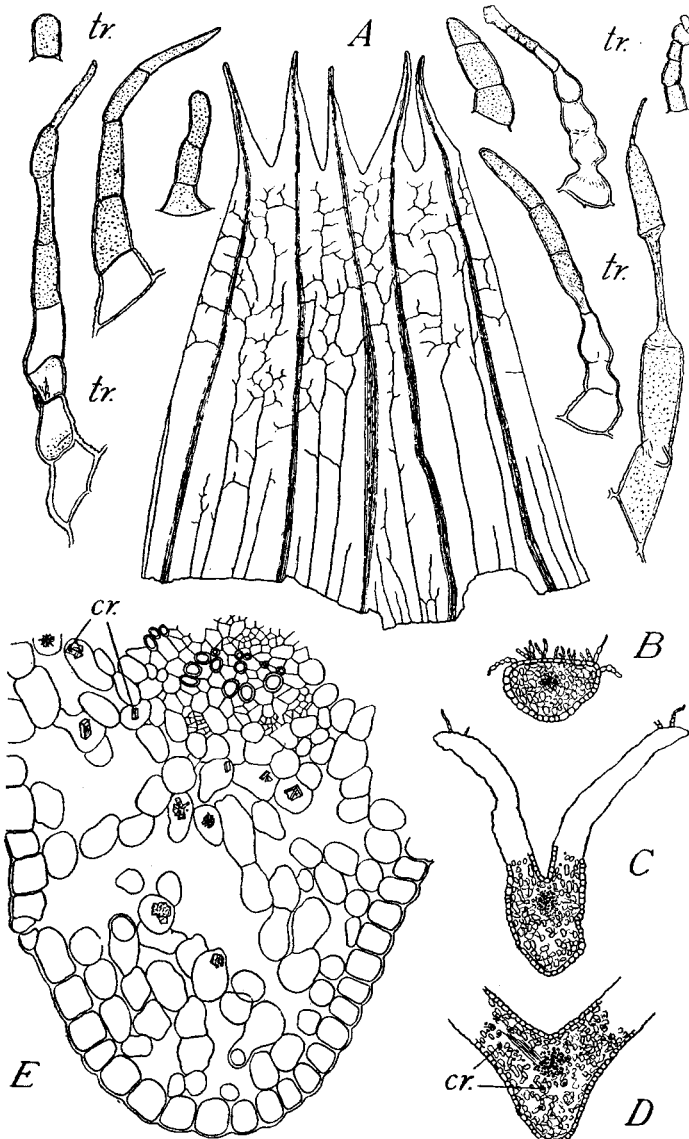


Fig. 2. *Datura stramonium* L., Calyx. A, calyx above the line of abscission, spread out to show its form and the venation, the shaded areas representing the five projecting ridges ( $\times 2.5$ ). B, C and D, transverse sections through the midrib at the tip of the lobe, the middle of the lobe and just above the line of abscission respectively ( $\times 30$ ). E, part of section D further magnified ( $\times 160$ ), to show the vascular strand and the cells of the mesophyll with inclusions, *tr*, peculiar trichomes on the edge of the lobes ( $\times 160$ ).

*Gynæcium* (Fig. 7A). *Ovary*, rounded-pyramidal, about 4 to 7 mm. long and 5 to 5 mm. in diameter at the widest part; covered by numerous erect spines in 4 patches along the sides; bilocular in the upper part and quadrilocular in the lower, due to the growth of false septa from the dorsal sutures of the carpels to the axile placentæ (Fig. 6, F, G, H and I); placentation axile, ovules numerous. *Style*, arising from the apex of the ovary, about 3 to 4 cm. in length increasing in diameter towards the apex, firm and almost erect, terminating in a bilateral, ovoid, capitate *stigma*.

*Fruit*. The ovoid fruit about 3 to 3.5 cm. long, surrounded below by the persistent base of the calyx which is strongly recurved; it is covered by numerous, unequal, sharp and rigid spines. The capsule opens by 4 valves extending from the apex to about half-way down. *Seeds*, numerous, brown or brownish-black, laterally flattened and subreniform, with shallow indefinite reticulate depressions on the surface, which is, in addition, finely pitted. The seeds measure about 3 to 3.7 mm. in length, 2.5 to 3 mm. in width and 1 to 1.6 mm. in thickness.

#### HISTOLOGY OF THE CALYX

*Outer (abaxial) epidermis*. On the lobes, the epidermal cells are small and have very sinuate anticlinal walls (Fig. 1, Ao); they measure approximately L and T = 15 to 21 to 30 to 75  $\mu$  and R = 21 to 30  $\mu$ .\* The cells on the upper part of the tube are similar to, but larger than those on the lobes; towards the base of the tube the cells have less sinuous anticlinal walls and at the very base, i.e., just above the line of abscission, the anticlinal walls are almost straight or slightly curved (Fig. 1, Bo). The cells on the persistent part of the calyx are smaller and polygonal in surface view (Fig. 1, Co). The cells at the middle of the tube measure approximately L and T = 30 to 45 to 90  $\mu$  and R = 21 to 36  $\mu$ ; in the region of the line of abscission, they measure L and T = 18 to 30 to 45 to 60  $\mu$ , R = 21 to 24 to 30  $\mu$ . The epidermal cells on the ridge over the midrib on the tube are rectangular to polygonal in surface view with straight or slightly curved anticlinal walls (Fig. 1, Vo). *Stomata* are frequent on the lobes and on the tube, but become less numerous or rare below the line of abscission; they are usually cruciferous (anisocytic). They are rare on the ridges over the midribs. *Trichomes*. Small *glandular* trichomes such as occur on the foliage leaves, having a short unicellular stalk and a comparatively large 5 to 6-celled pyriform head, occur frequently on the lobes and upon the tube, being less numerous towards the base. Conical warty *covering* trichomes occur on the lower half of the tube but rarely on the lobes; those on the ridge over the midribs are often blunt at the apex. The persistent part of the calyx bears small *glandular* trichomes as well as *covering* ones.

At the line of abscission, a granular substance appears along the walls of certain cells (Fig. 1, Lo); this appears to be the product of enzyme

\* When recording measurements, the letters L, T and R are used to indicate measurements in a longitudinal, tangential and radial direction respectively, the directions having reference to the axis of the relevant plant member.

FLOWERS OF *DATURA STRAMONIUM* L. AND *D. TATULA* L.

action, which dissolves the middle lamella and leads eventually to the detachment of the calyx. The cells, after abscission, retain their form and bear no evidence of tearing. The granular substance was found

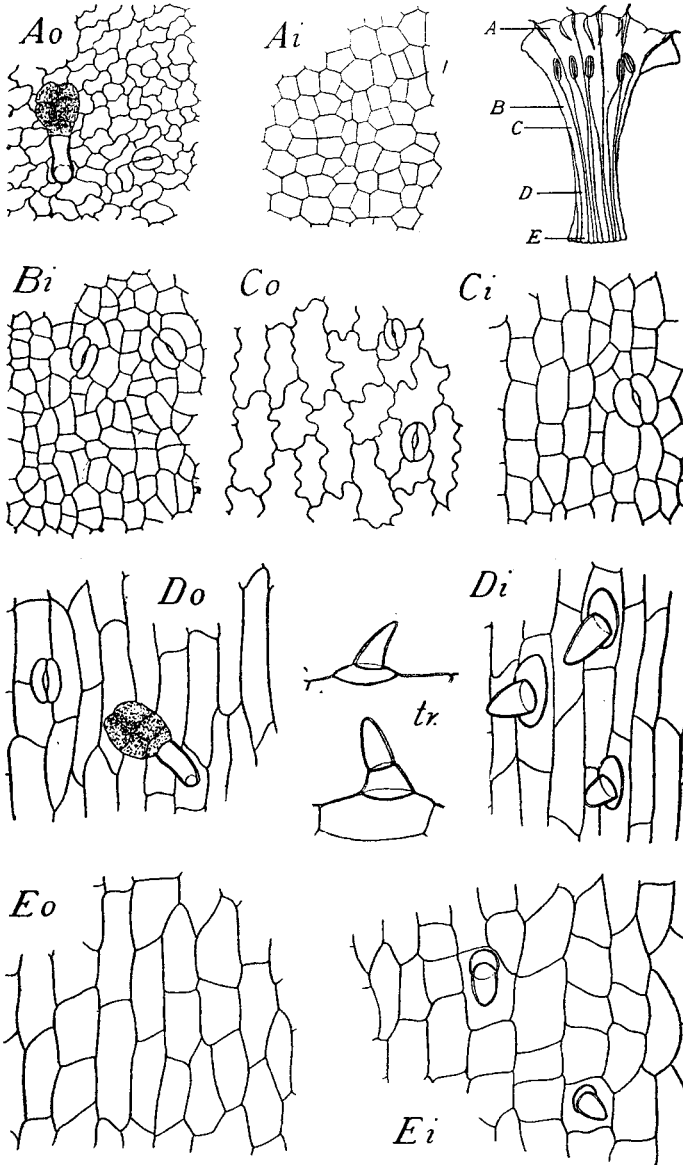


Fig. 3. *Datura stramonium* L., Corolla. Ao, outer epidermis at A (as indicated on diagram, top right); Ai, inner epidermis at A; Bi, inner epidermis at B; Co, outer epidermis at C; Ci, inner epidermis at C; Do, outer epidermis at D; Di, inner epidermis at D; Eo, outer epidermis at E; Ei, inner epidermis at E, *tr*, covering trichomes on the inner epidermis at the base. All  $\times 160$ .

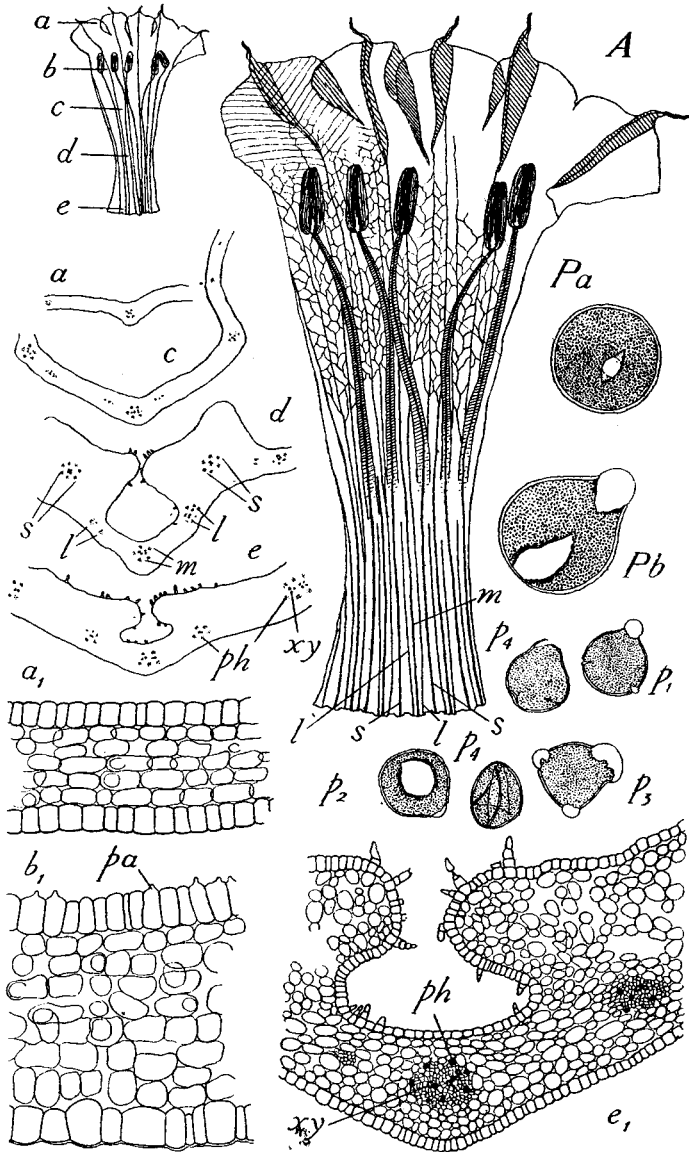


Fig. 4. *Datura stramonium* L. A, corolla above the line of abscission, spread out showing venation and epipetalous stamens, the venation of the lobes is shown on the extreme left lobe only ( $\times 2$ ). *a*, *c*, *d* and *e*, a series of diagrams of transverse sections through the corolla at various levels indicated in the diagram, top left ( $\times 15$ ). *a<sub>1</sub>*, *b<sub>1</sub>* and *e<sub>1</sub>*, sections at *a*, *b* and *e*, further magnified to show the details of the mesophyll, papillae and vascular strands, *a<sub>1</sub>* and *b<sub>1</sub>*  $\times 160$ , *e<sub>1</sub>*  $\times 80$ . *Pa*, pollen grain showing indistinct furrow and pore ( $\times 280$ ); *Pb*, pollen showing intine extruding from the pore ( $\times 280$ ); *p<sub>1</sub>*, *p<sub>2</sub>*, *p<sub>3</sub>*, pollen grains showing forms of pores and furrows ( $\times 160$ ); *pa*, empty burst exteriors of pollen grains ( $\times 160$ ); *l*, lateral vein branching from the base of the midrib; *m*, midrib; *pa*, papilla; *ph*, phloem; *s*, vein leading to a stamen; *xy*, xylem.

## FLOWERS OF *DATURA STRAMONIUM* L. AND *D. TATULA* L.

to dissolve when preparations were left in solution of chloral hydrate and glycerin for a few days.

*Inner (adaxial) epidermis.* The cells on the lobes and on the upper part of the tube are very sinuous; they become gradually larger towards the base of the tube (Fig. 1, Ai and Bi). The cells show elongation over the midribs in the tube, accompanied by a slight reduction in sinuosity. On the lower region of the persistent part of the calyx, the cells are polygonal with straight anticlinal walls (Fig. 1, Ci). The cells of the inner epidermis measure approximately  $L$  and  $T = 21$  to  $75$  to  $120$  to  $180 \mu$  and  $R = 18$  to  $24$  to  $36 \mu$ ; on the lobes they approximate the lower limits. Cruciferous (anisocytic) *stomata* occur occasionally on the lobes and on the tube, but are absent below the line of abscission. *Trichomes* are very rare or absent. On the margin of the calyx lobes, there is an abundance of covering trichomes of various forms, which differ from those on other parts of the calyx (Fig. 2, tr.).

*Trichomes.* The dimensions of the clavate *glandular* trichomes are as follows: the stalk is about  $30$  to  $45 \mu$  in length and  $15 \mu$  in diameter, the head about  $36$  to  $60 \mu$  in diameter. The *covering* trichomes of the outer epidermis are  $2$  to  $5$ -celled, uniseriate, conical and warty; those over the midrib have a rounded tip and sometimes a smooth cuticle. The covering trichomes along the edge of the lobes have a variety of forms; some are  $1$ - to  $3$ -celled with a blunt rounded tip; others are  $3$ - to  $8$ -celled, the cells being often collapsed and flattened alternately at right angles to one another while some cells have localised rounded enlargements; the majority of the cells of these trichomes are covered with a warty cuticle and the cuticle over many of the basal cells is transversely striate; very rarely a branched trichome occurs. The covering trichomes of the calyx measure about  $60$  to  $165$  to  $630 \mu$  in length and  $24$  to  $36 \mu$  in basal diameter.

*Mesophyll* (Fig. 2, B, C, D and E). The mesophyll consists of about  $3$  to  $6$  layers of parenchyma having large intercellular spaces. In the ridge over each midrib the spongy parenchyma is more loosely arranged than in the corresponding tissue in the interneural regions. The cells of the mesophyll have numerous *crystals* either as solitary prisms or other irregular shapes or aggregates of prisms (Fig. 2, D and E, cr). The crystals become more abundant towards the base and also along the midribs, where single prisms become more frequent. Below the line of abscission, idioblasts filled with micro-sphenoidal crystal sand are common.

*Venation* (Fig. 2, A). Each sepal has a well-marked midrib which runs almost directly into the tip of each lobe. Smaller veins arising at the base from various points between the midribs run parallel to the latter and terminate at various levels in the tube. All veins have fine branches which anastomose with each other. There are no marginal veins on the lobes. In transverse section, each midrib has a small vascular bundle consisting of an arc of slender spirally-thickened xylem vessels surrounded by groups of phloem tissue.

## HISTOLOGY OF THE COROLLA

*Outer (abaxial) epidermis.* On the lobes and on the throat of the tube, the cells are small, sub-rectangular to polygonal with slightly sinuous anticlinal walls (Fig. 3, Ao); they measure approximately L and T = 9 to 12 to 21 to 45  $\mu$  and R = 15 to 24  $\mu$ . On the tube, half way down the corolla, the cells are larger and sub-rectangular with sinuous anticlinal walls (Fig. 3, Co); they measure approximately L and T = 15 to 30 to 45 to 60  $\mu$  and R = 24 to 30 to 48  $\mu$ . From the middle of the corolla tube to the base the cells are rectangular to polygonal, with almost straight anticlinal walls (Fig. 3, Do and Eo); the cells on the lower half of the tube measure approximately L = 60 to 90 to 225  $\mu$  and T = 15 to 24 to 39  $\mu$  while at the base of the tube, L and T = 9 to 24 to 36 to 45  $\mu$ , and R = 24 to 30 to 45  $\mu$ . Ranunculaceous (anomocytic) *stomata* are present on the lobes and upon the throat of the tube; cruciferous (anisocytic) *stomata* occur at the middle of the tube, but are less numerous; *stomata* are absent at the base. Small glandular *trichomes*, similar to those on the calyx lobes, are present in small numbers on the outer epidermis of the corolla lobes.

*Inner (adaxial) epidermis.* On the lobes, the cells are small and polygonal with straight anticlinal walls (Fig. 3, Ai); they measure approximately L and T = 9 to 15 to 18 to 30  $\mu$  and R = 15 to 24  $\mu$ . On the middle of the corolla tube, the cells are somewhat larger, sub-rectangular to polygonal, with straight or slightly curved anticlinal walls (Fig. 3, Bi and Ci); they measure approximately L and T = 18 to 21 to 30 to 60  $\mu$  and R = 18 to 27 to 36  $\mu$ . Many cells on the throat of the corolla and in certain specimens on the lobes as well, have small inconspicuous papillae (Fig. 4, b<sub>1</sub>). At a point about two-thirds down the length of the tube, the cells are sub-rectangular and axially elongated; further down near the base, they are more isodiametric (Fig. 3, Di and Ei). On the lower part of the corolla, the cells measure approximately L = 30 to 75 to 120  $\mu$ , T = 15 to 21 to 24  $\mu$  and R = 15 to 24 to 30  $\mu$ . *Stomata* are absent on the lobes; a few ranunculaceous (anomocytic) *stomata* occur at the middle of the tube; they are absent towards the base. Covering *trichomes* are fairly numerous on the lowest third of the tube; they are 1 to 3-celled uniseriate and conical, with a short dome-shaped basal cell and a small conical cell at the apex; they measure about 15 to 30  $\mu$  in length and 24 to 30  $\mu$  in basal diameter (Fig. 3, tr).

*Mesophyll* (Fig. 4, a, b, c, d, a<sub>1</sub>, b<sub>1</sub> and e<sub>1</sub>). The mesophyll of the tube consists of 5 to 8 layers of thin-walled spongy parenchyma; that of the lobes consists of about 5 layers of smaller, more closely arranged cells, forming a thinner structure. The outgrowths caused by the adnated filaments consist of a spongy mesophyll having large intercellular spaces. *Calcium oxalate* occurs as small single crystals or as aggregates in all parts of the corolla and is more abundant towards the base. Large crystalline masses of unknown composition, such as were found by Timmerman<sup>4</sup> in the leaves of *D. metel*, occur sporadically in various parts of the mesophyll of the corolla tube.



## FLOWERS OF *DATURA STRAMONIUM* L. AND *D. TATULA* L.

*Venation* (Fig. 4, A). Each petal has a well-marked midrib running directly into the tip of the lobe. Two main branches arising on either side of each midrib near the base, terminate at the base of the lobe; in the upper half of the tube all the veins have lateral branches which anastomose freely. In the lobes, each midrib gives out, almost at right angles to itself, parallel branches which extend to the edge of the lobe. In transverse section, the midrib shows a xylem consisting of a few slender spiral vessels, surrounded by groups of phloem which are separated by thin-walled small-celled parenchyma (Fig. 4, d, e and e<sub>1</sub>).

### HISTOLOGY OF THE STAMENS

*Filament*. The epidermal cells on the free part of the filament are sub-rectangular to polygonal in surface view and are elongated along the direction of the axis (Fig. 5, B); they are covered by a thin cuticle which in certain specimens shows longitudinal striations; the cells measure approximately  $L = 120$  to  $180$  to  $300 \mu$   $T = 15$  to  $30 \mu$  and  $R = 24$  to  $30$  to  $42 \mu$ . The epidermal cells on the adnated part of the filament resemble the neighbouring cells on the corolla. *Stomata* and *trichomes* are absent on the free part of the filament; 1- to 3-celled conical covering trichomes are present on the adnated part of the filaments and resemble those of the corolla tube, associated with these are many larger 1- to 6-celled uniseriate covering trichomes; the trichomes measure approximately  $28$  to  $700 \mu$  in length and  $14$  to  $100 \mu$  in basal diameter (Fig. 5, tr). The *cortex* as seen in transverse section, consists of about 7 rows of thin-walled rounded paraenchyma loosely arranged; the cells are about  $15$  to  $42$  to  $60 \mu$  in diameter. The vascular strand resembles that of the corolla midribs (Fig. 5, A).

*Anther*. The *connective* has an epidermis consisting of sub-rectangular cells elongated in the direction of the axis; the cuticle is striated longitudinally. The vascular strand consists of slender spiral vessels appearing in transverse section (Fig. 5, C), in the form of an ellipse and surrounded by several small groups of phloem; at the centre a lacuna is usually present. The vascular cylinder is surrounded by a few layers of parenchymatous cells; the remainder of the tissue consists of spongy parenchyma. The outer epidermis of the *lobes* consists of sub-rectangular to polygonal cells usually elongated at right angles to the axis (Fig. 5, D and H); the cells measure approximately  $L = 15$  to  $30 \mu$ ,  $T = 45$  to  $60$  to  $120 \mu$  and  $R = 15$  to  $30 \mu$ ; cruciferous (anisocytic) *stomata* occur occasionally. The lobes bear frequent slender, finely warty, 2- to 5-celled uniseriate covering trichomes on the outer epidermis near the line of dehiscence; the trichomes have micro-crystals in some of the cells; they measure approximately  $140$  to  $420 \mu$  in length and  $6$  to  $15 \mu$  in basal diameter. The *fibrous layer* (Fig. 5, E, F, G and H) is one-cell wide near the line of dehiscence, but gradually becomes 2- to 4-cells wide near the connective. The fibrous layer often extends quite across the dorsal surface of the connective; the cells give only a slight reaction for lignin. The cells of the fibrous layer measure approximately  $L = 15$  to  $24 \mu$ ,  $T = 30$  to  $45$  to

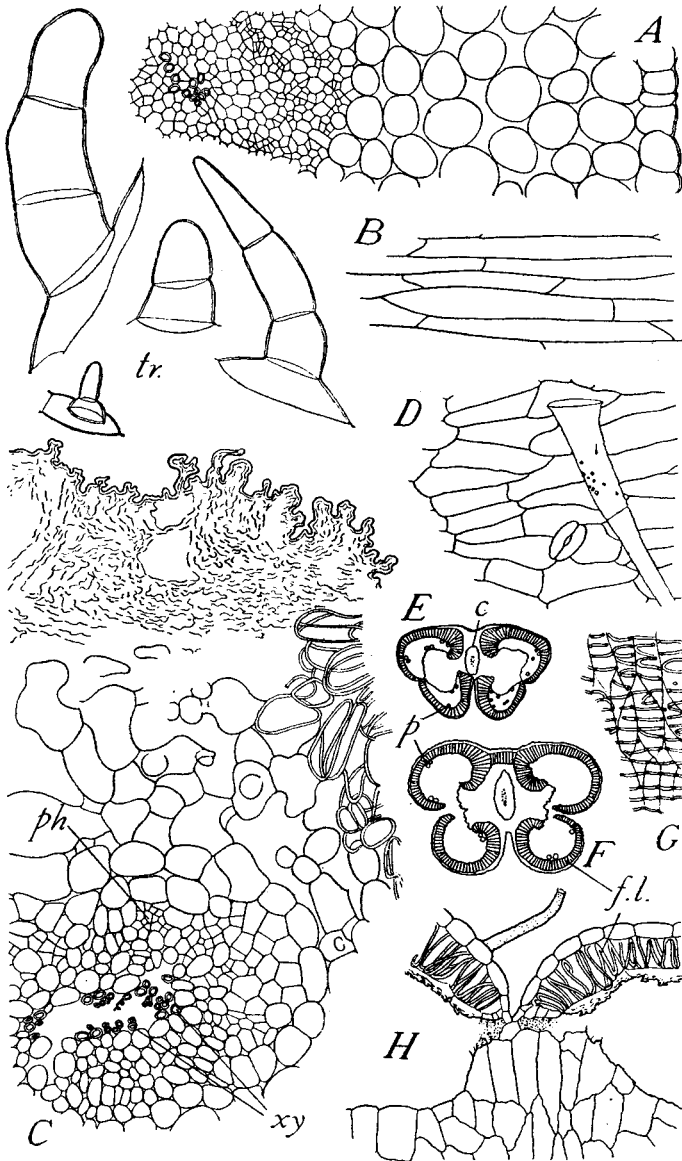


Fig. 5. *Datura stramonium* L. Stamen. A, transverse section through filament. B, epidermis from filament; C, transverse section through connective of the anther; D, epidermis of the anther lobe bearing trichome with crystals in the basal cell; E and F, diagrams of sections through the anther of a bud and of a flower respectively ( $\times 15$ ); G, fibrous layer of anther in surface view; H, transverse section of anther wall at line of dehiscence; *c*, connective; *f.l.*, fibrous layer; *p*, pollen grains; *ph*, phloem; *tr*, trichomes on adnated part of filament; *xy*, xylem. All  $\times 160$ , except E and F.

60  $\mu$  and R = 15 to 36 to 60  $\mu$ . Remains of the tapetum are often visible lining the inner surface of the pollen sac.

The *pollen grains* (Fig. 4, P and p) are spherical, their diameter being 48 to 60 to 78  $\mu$  when mounted in lactophenol. When boiled in solution of chloral hydrate the diameter is greater by about 7  $\mu$  and if the boiling is vigorous many of the grains are ruptured. There are three pores which vary in distinctness and in size, measuring from 12 to 28  $\mu$  in diameter; the margin of the pore is sometimes strongly marked (Fig. 4, P<sub>b</sub>, P<sub>2</sub> and p<sub>3</sub>) and in other pollen grains scarcely visible (Fig. 4, P<sub>a</sub> and P<sub>1</sub>). Germinal furrows are faintly outlined and are usually only slightly larger than the pores (Fig. 4, P<sub>a</sub> and p<sub>1</sub>); in many grains, where the intine has become extruded, the furrows appear as splits in the circumference of the pore outline (Fig. 4, P<sub>b</sub>). Zander<sup>5</sup> was unable to see furrows, but careful investigation indicates that they are present, though small and often indistinct. The exine has a markedly irregularly warty surface. The pollen contains oil globules and minute starch grains, the latter measuring about 1 to 5  $\mu$  after treatment with a solution of chloral-iodine.

#### HISTOLOGY OF THE CARPELS

*The Ovary.* The cells of the *outer epidermis* (Fig. 6, A and B), of the ovary wall and of the numerous spines which cover the ovary, are polygonal in surface view with straight or slightly curved anticlinal walls; they measure L and T = 6 to 18 to 30  $\mu$  and R = 15 to 24  $\mu$ . *Stomata* are rare and ranunculaceous (anomocytic). Trichomes (Fig. 6, t<sub>1</sub>, t<sub>2</sub> and t<sub>3</sub>) vary in frequency of occurrence, they are mostly glandular with a 1- to 4-celled uniseriate stalk and a 1- to 5-celled multicellular rounded or clavate head. A few small 1- to 3-celled uniseriate trichomes with a rounded apex are present, as also are a few 2- to 3-celled warty conical covering trichomes. The *inner epidermis* consists of slightly smaller polygonal cells with almost straight walls (Fig. 6, C). *Stomata* occur occasionally; they are comparatively larger than the surrounding cells and ranunculaceous (anomocytic). The *mesophyll* consists of round-celled parenchyma which contains numerous minute starch grains; calcium oxalate occurs as prisms or irregularly shaped pieces and there are frequent idioblasts containing crystal sand (Fig. 6, G, id.). The *spines* (Fig. 6, F, sp., D and E) at a quite early stage of their growth show in transverse section about 15 groups of procambial tissue arranged in a circle near the periphery; these groups develop into vascular strands with spiral xylem elements in the very young fruit. The epidermal cells of the *septum* are similar to those of the ovary wall. Starch grains and crystals, similar to those in the ovary wall, are present in the mesophyll of the septum and of the placenta. The young *ovules* consist of undifferentiated parenchyma.

*The Style* (Fig. 7, A, B and G) is erect, firm and slightly thicker towards the apex; the epidermis resembles that of the filaments, but is covered with a longitudinally striated cuticle. The epidermal cells measure approximately L = 150 to 225 to 300  $\mu$ , T = 16 to 24 to 30  $\mu$  and R = 15 to 30  $\mu$ . *Stomata* (cruciferous) are rare and *trichomes* are absent from the style.

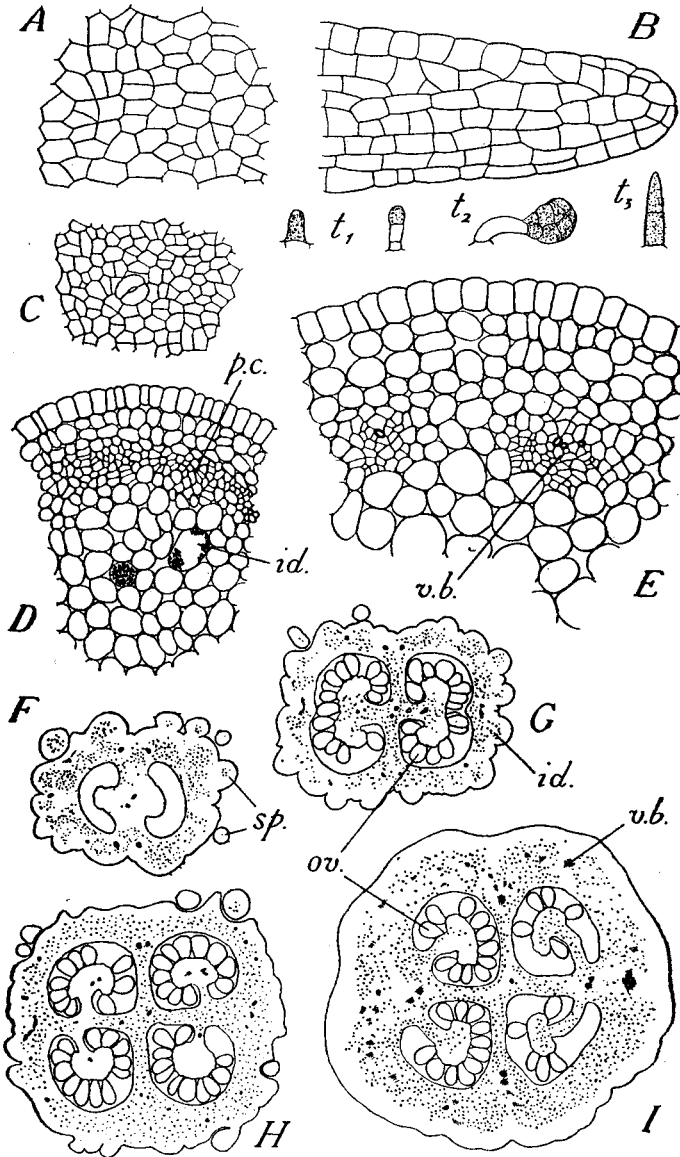


Fig. 6. *Datura stramonium* L., Ovary. A, outer epidermis of the ovary wall; B, epidermis of a developing spine; C, inner epidermis of the ovary wall; D, transverse section through a young spine of the ovary showing procambial strands; E, transverse section through an older spine from a very young fruit showing development of vascular strands; F, G, H and I, series of transverse sections through the ovary showing the variation in the number of loculi and the presence of a false septum in the lower part of the ovary ( $\times 15$ ); *id.*, crystal-sand idioblast; *ov.*, ovules; *p.c.*, procambial strand; *sp.*, spine; *t<sub>1</sub>*, *t<sub>2</sub>*, *t<sub>3</sub>*, covering, glandular and warty trichomes respectively from the outer epidermis of the ovary and of the spines; *v.b.*, vascular bundle. All  $\times 160$ , except F, G, H and I.

FLOWERS OF *DATURA STRAMONIUM* L. AND *D. TATULA* L.

The ground tissue consists of a round-celled parenchyma, many cells of which contain calcium oxalate in the form of small isolated crystals, either as prisms or of irregular shapes; small starch grains are present in many of the cells. Occasionally, large crystalline masses of unknown composition occur in different parts of the style (Fig. 7, B, cr.). In transverse section (Fig. 7, B and G), the style shows a central oval region of very thin-walled cells about 3 to 9  $\mu$  in diameter; frequently there is an irregular lacuna at the centre; on each side of the oval region is a vascular strand; the remaining tissue consists of a layer of about 12 rows of

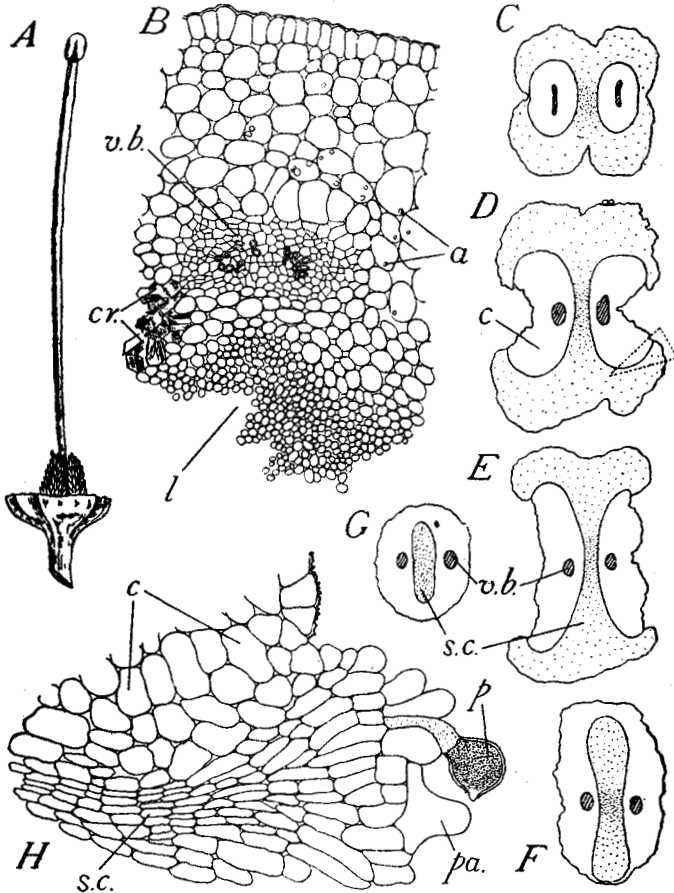


Fig. 7. *Datura stramonium* L. A, entire gynoecium with persistent part of the calyx ( $\times 2$ ); B, transverse section through the style ( $\times 160$ ); C, D, E, F and G, diagrams of series of sections from the apex of the stigma to the style, showing the proliferation of the small-celled tissue in the centre of the stigma resulting in the formation of the papillose surface ( $\times 15$ ); H, triangular area outlined by dotted lines in D, further enlarged ( $\times 160$ ); a, starch grains; c, ground tissue; cr, crystalline mass of unknown composition; l, lacuna; p, pollen with developing pollen-tube; pa, papillose cell; s.c., small-celled tissue; v.b., vascular bundle.

larger thin-walled parenchymatous cells, about 15 to 30  $\mu$  in diameter, with small intercellular spaces.

*The Stigma* (Fig. 7, A, C, D, E, F and H) is ovoid in shape and is covered by a papillose receptive surface which has on each side a small vertical groove which increases in width towards the base; the papillæ are short, cylindrical and rounded at the apex, the papillose cells measuring approximately 15 to 30 to 75  $\mu$  in length and 15 to 30  $\mu$  in diameter at the base. The stigma has a vascular strand on either side of a central region of small, thin-walled, loosely-arranged cells; this central region extends its growth at right angles to the plane containing the vascular strands until it reaches the epidermis which is then ruptured and the small-celled tissue emerges to form a papillose cap to the stigma. Pollen grains can often be observed attached to the papillose surface with the pollen tube growing into the style. The cuticle covering the epidermis in the grooves of the stigma is strongly striated.

#### *Datura tatula*

Linnaeus, in his original description of the plant *Datura tatula* in his *Species Plantarum*, second edition<sup>6</sup>, 1762, states that it is similar to *D. stramonium* with the difference of purple colouration of the stem and the pale blue corolla. The description of the drug, Stramonium, in the British Pharmacopoeia for 1932 and 1948 includes the species *D. tatula*. Various workers have expressed the opinion that since *D. tatula* Linn. is identical in all respects with *D. stramonium* Linn., but for the purple colouration, it may be regarded as a variety of *D. stramonium*; Timmerman<sup>4</sup> found a slight difference in the size of the trichomes of the leaves of the two species. The following description of the flower of *D. tatula* is comparative with that of the flower of *D. stramonium* immediately preceding this description.

*Material.* The only available specimens used for this study were obtained from the Chelsea Physic Garden in July, 1949.

#### HISTOLOGY

*Calyx.* The calyx shows no difference from that of *D. stramonium* except that in addition to the characteristic trichomes described under *D. stramonium* as occurring along the edge of the lobes, there are also in this position a few trichomes having multicellular glandular heads (Fig. 8, tr<sub>1</sub>). The covering trichomes are about the same length as those of *D. stramonium* but are broader at the base, measuring up to 90  $\mu$  in basal diameter.

*Corolla.* No difference in structure from that of *D. stramonium* was observed.

*Andræcium.* The only slight difference observed was in the trichomes on the adherent part of the filament, some cells of which are somewhat barrel-shaped instead of terete (Fig. 8, tr<sub>2</sub>). The *pollen grains* are identical with those of *D. stramonium* in all respects except that the exine on a few grains appears to have a tendency towards streaky striations instead of the usual irregular markings.

FLOWERS OF *DATURA STRAMONIUM* L. AND *D. TATULA* L.

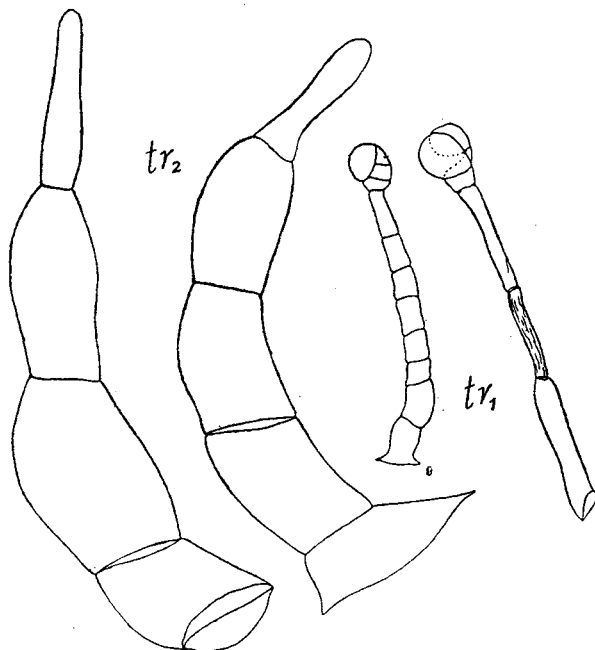


Fig. 8. *Datura tatula* L.  $tr_1$ , glandular trichomes from the edge of the calyx lobes;  $tr_2$ , covering trichomes from the adnated part of a filament ( $\times 100$ ).

*Gynæcium*. No features of anatomy could be observed which distinguish the gynæcium of *D. tatula* from that of *D. stramonium*.

SUMMARY AND POWDER

The diagnostic characters of the powdered flowers may be regarded as supplying also a summary of the important histological features of the unground flowers.

*Powdered Flowers*. Dried flowers of *D. stramonium*, reduced to No. 90 powder, yield a greyish-green powder with an irritant and typically leafy odour. The usual reagents were used for the examination of the powder and the characters helpful in identification are listed in order of importance, chloral hydrate being the mountant.

1. Pollen grains, spherical, about 55 to 63 to 80  $\mu$  in diameter, having 3 pores, with the intine often extruding from the pores; the exine has an irregularly warty surface.

2. Broken stalks of covering trichomes with a warty surface, rarely smooth, some fragments with collapsed cells; occasionally a detached glandular head of a clavate trichome.

3. Numerous fragments of the calyx intersected by slender spiral vessels, having wavy-walled epidermal cells with cruciferous (anisocytic) stomata and containing calcium oxalate crystals in the mesophyll in the form of isolated prisms or typical aggregates of prisms or irregular-shaped

crystals. The arrangement of the crystals in the vein-islets is similar to that in the leaf.

4. The only feature which distinguishes the powder of the dried flowers of *D. tatula* from that of *D. stramonium* is that fragments of corolla and anther lobes yield a transient pink colouration when mounted in cold solution of chloral hydrate.

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