Transactions of the Botanical Society of Edinburgh

Publication details, including instructions for authors and subscription information:

<http://www.tandfonline.com/loi/tped18>

Notes on the Potentilleæ

R. A. Robertson M.A., B.Sc.

Published online: 29 Nov 2010.

To cite this article: R. A. Robertson M.A., B.Sc. (1897) Notes on the Potentilleæ, Transactions of the Botanical Society of Edinburgh, 21:4, 329-341, DOI: [10.1080/13594869709441308](http://dx.doi.org/10.1080/13594869709441308)

To link to this article: <http://dx.doi.org/10.1080/13594869709441308>

PLEASE SCROLL DOWN FOR ARTICLE

Taylor & Francis makes every effort to ensure the accuracy of all the information (the "Content") contained in the publications on our platform. However, Taylor & Francis, our agents, and our licensors make no representations or warranties whatsoever as to the accuracy, completeness, or suitability for any purpose of the Content. Any opinions and views expressed in this publication are the opinions and views of the authors, and are not the views of or endorsed by Taylor & Francis. The accuracy of the Content should not be relied upon and should be independently verified with primary sources of information. Taylor and Francis shall not be liable for any losses, actions, claims, proceedings, demands, costs, expenses, damages, and other liabilities whatsoever or howsoever caused arising directly or indirectly in connection with, in relation to or arising out of the use of the Content.

This article may be used for research, teaching, and private study purposes. Any substantial or systematic reproduction, redistribution, reselling, loan, sub-licensing, systematic supply, or distribution in any form to anyone is expressly forbidden. Terms & Conditions of access and use can be found at <http://www.tandfonline.com/page/terms-and-conditions>

but rather, at least in its more important aspects, the stimulation of the protoplast to an increased vital activity leading up to the development of the zymogen itself, which, in its turn, under the influence of the same rays, becomes converted into a zymase, by which the absorption of the stored food materials is rendered possible.

LITERATURE REFERRED TO.

1. Stebler.—Ueber der Einfluss des Lichtes auf die Keimung.—Bot. Centralbl., vii. Bd. p. 157. 1881.
2. Cieslar, Ad.—Untersuch. u. d. Einfluss d. Lichtes a. d. Keimung d. Samen.—Forschungen auf des Gebiete der Agricultur Physic, vi. Bd. 1893.
3. Heinricher, E.—Ein Fall beschleunigter Wirkung d. Lichtes a. d. Samenkeimung. Vorlauf. Mitth.—Ber. d. D. Bot. Gesellschaft. Jahrg. xvii., H. 8 pp. 308–316. 1899.
4. Forest Heald.—Conditions for the Germination of the Spores of Bryophytes and Pteridophytes.—Bot. Gaz. xxvi. pp. 25–45. 1899.
5. Bokorny, Th.—Einiges über die Proteinstoffe der Samen.—Bot. Centralbl. lxxxii. Bd., No. 10, 11, p. 289. 1900.
6. Green, J. R.—On the Action of Light on Diastase and its Biological Significance.—Phil. Trans. Bot. vol. clxxxviii. 1897.
7. Klebs, G.—Ueber d. Organisation d. Gallerte b. Einigen Algen u. Flagellaten.—Untersuch. a. d. bot. Inst. z. Tübingen.
8. Balfour, B.—Botanical Lecture Experiment.—Nature, vol. xxxv. p. 126. 1886.

NOTES ON THE POTENTILLÆ. I.—THE FLOWER. By R. A. ROBERTSON, M.A., B.Sc. (With Plates.)

(Read 12th July 1900.)

On account of their variability, the *Potentillas* have always been a confusing group, and the statements made by systematists as to the number of species differ widely. Nestler ("Monographia de *Potentilla*") in 1816 enumerated 68 species, and varieties in addition. The shapes of the leaves and the characters of the torus were utilised for the subdivisions of the group. In De Candolle's "Prodromus" (1825), the genus *Potentilla* is included in the tribe Dryadeæ of the Rosaceæ. 106 species, besides sub-species and varieties, are described. The genus is subdivided into three sections, based on such characters as the colour and shape of the petals, as well as the manner of branching of the foliage leaves.

In Lehmann's "Revisio Potentillarum" (Nov. Act. xxiii. Supp., 1856), 204 species, and many varieties, are minutely described. Here the genus is elaborately subdivided—primary characters being derived from the general habit, branching of the leaves, and the inflorescence axes, with the position of the individual flowers. For the ultimate divisions, characters are derived from the carpels—glabrous and villous,—and the colour and shape of petals.

Bentham and Hooker ("Genera Plantarum," 1865) include the genus, along with *Dryas*, *Geum*, *Fragaria*, and others, in the tribe Potentillæ of Rosaceæ. 120 species are admitted, but it is pointed out that the great variability of the group has led to the number of species being raised to 220 by other authors.

By Baillon ("Nat. Hist.," 1871) they are placed in the same series as *Fragaria*, *Sibbaldia*, *Rubus*, *Geum*, and *Dryas*. He gives 250 as the figure for the species, but remarks that this should be reduced by one-third.

Eichler ("Bluthendiagrammen," 1878) includes them in the same tribe as the Rubææ.

Schimper ("Text Book of Botany," 1894) follows Eichler, forming of them, along with *Fragaria*, *Rubus*, etc., the sub-family Ruboideæ. Warming ("Systematic Botany," 1895) repeats Bentham and Hooker, including the genus with *Comarum*, *Fragaria*, *Geum*, and *Dryas* in the tribe Potentillæ. Since Lehmann's "Revisio" was published new species are described, so that if there is a tendency to contract the group on the one hand by amalgamating old species, it is being slowly added to on the other by the discovery or manufacture of new forms.

It was on purpose to ascertain whether there might not be some features in the minute anatomy that might serve as auxiliary character for purposes of classification that this study of the anatomy of the group was entered upon. It was begun on the suggestion of Dr. Macfarlane, and material was supplied, at first, from the Botanic Garden, Edinburgh, to the Regius-Keeper of which I take this opportunity of tendering my best thanks. Subsequently researches were made on material grown from seed supplied by Prof. Cornu, of the Jardin des Plantes, Paris, to whom also I express my indebtedness.

In the course of the examination the inflorescence axes have been studied, and the leaves and epidermal appendages. In regard to the latter, if one exclude the pilose papillæ of the petals, the hairs are of two kinds—(a) thickwalled, conical, usually unicellular, with a bulbous base often partly ensheathed by a rosette of epidermal cells; and (b) multicellular, capitate, glandular hairs, similar to those of the Primulaceæ. The glandular head is usually of a single cell, but may be bicellular, with the septum vertical. One or both kinds of hairs may occur on the surfaces, margins, and apices of the leaves, on the axes of inflorescence, and on epicalyx and calyx segments. On the torus only the unicellular hairs occur, and these also it is which form the barrier ring over, and internal to, the nectaries.

In addition to the general anatomy of the flower, the minute structure of the various parts has been studied, as well as the mature achenes, and the seedlings at various stages.

In the following account of the flower, chiefly those points are dealt with which appear to be of value for purposes of classification.

The flowers may be solitary, but are frequently grouped into somewhat open inflorescences composed of dichasial cymes arranged on a primary racemosely branched axis.

In section, the flower shows a shallow concave torus shaped liked the bottom of a bottle, with a solid core. The periphery bears a circle of green segments, usually five in number, forming the epicalyx: each of these segments has been described as composed of the two fused stipules of adjacent sepals—this because the epicalyx segments may bifurcate. Examination of the developing flower, and of the vascular supply of the adult segments, cause me to differ from this commonly accepted view, and regard the epicalyx segments as integral units as much so as each sepal in fact is.

Characters of the epicalyx of use for systematic work are the relative length of the segments; they may be longer or shorter, narrower or wider than the sepals. Again, their margins may be minutely toothed, each tooth topped by a hair, and occasionally having a water-gland.

The character and distribution of the hairs, and the shape of the apex are variable. Thus the latter may be acute, acuminate, or bifid, or even trifid, from the appearance of two large lateral teeth some little way down. Each segment (Fig. 1, *ep.*) has a main rib and two smaller laterals, which converge apically and form a vascular fan communicating with a water-gland.

This water-gland usually occupies a shallow dimple on the upper surface of the leaf, and has several water-stomata; its position is indicated by a red coloration of the segment apex.

The *Calyx* consists of four or five sepals of a similar structure to the epicalyx segments, and alternating with them. The same variation in the epidermal appendages and their distribution occurs, the hairs being frequently longest along the line of the ribs, especially the main ribs. The vascular supply (Fig. 1, *sep.*) is by three main ribs, the two laterals anastomosing with those of the adjacent epicalyx segments.

All three converge apically, and meet under a water-gland having similar structure and distinguished by a similar colour as in the epicalyx segments. This coloration, indicating water-glands, is found at the apices and teeth of the ordinary leaves also. The aestivation of the sepals is valvate.

In the upper mesophyll cells of the sepals and epicalyx segments are enormous quantities of oxalate of lime in rosette crystals.

Both epicalyx and calyx are persistent, and enclose the mature fruit.

The *Corolla*, in colour, white, yellow, or red, or some combination, is of four to five petals alternate with the sepals. The petals vary in shape, perhaps the commonest is the obcordate; each has a very short claw which joins the torus by a very constricted neck. Their upper surface bears the usual petaline pilose papillæ, and their epidermal cells have a wavy sinuous outline; their size in relation to the sepals varies, being larger or smaller—sometimes half the size, at other times almost double the size. In consequence of their constricted claw they fall off very readily. Their vascular supply is derived from the main

trunk that supplies the epicalyx segment to which each petal is opposite (Fig. 12, *p.v.s.*).

Andræcium. — According to Payer (*Traité d'organ. comp. de la fleur.*) this is either isostemonous with five stamens opposite the sepals (*Sibbaldia*), or opposite the petals (*Chamaerhodos*), or diplostemonous, with one whorl superposed to the sepals, and another to the petals (*Horkelia*.) Further, diplostemony may arise by deduplication, ten stamens being found in a single whorl in pairs, superposed either to sepals or petals.

Dickson's studies on the stamens of the Rosaceæ are found in "Journ. of Bot.," vols. iii. and iv., and "Trans. Bot. Soc.," vol. viii. In the latter he points out that the andræcium of the *Potentillas* is arranged in the form of a series of festoons stretching from petal to petal, each festoon being concave externally. He regarded the andræcium as composed of five compound stamens, the terminal lobe of each developed as a petal so called, and the lateral lobes as fertile stamens. Where a stamen is exactly superposed to a sepal, he regarded it as stipular in character—an interstaminal lobe,—bearing the same relation to the compound stamens on either side of it as the epicalyx segment does to its adjacent sepals. Dickson examined the andræcia of twenty-nine species, and founded three types thereon of staminal arrangement.

Type 1 had twenty stamens arranged in five festoons of three each, and five single' oppositipetalous stamens. This is the commonest type among the Rosaceæ; it occurs, for example, in *Fragaria* and *Comarum*.

Type 2, with thirty stamens arranged in five festoons of five, and five oppositipetalous stamens. This occurred in three species.

Type 3, with twenty-five stamens in five festoons of five. This occurred in two species—*P. fruticosa*, L.; and *P. rupestris*, L.

Dickson emphasised the great importance of these staminal arrangements in establishing, or at least limiting, minor groups. My observations confirm the above, and enable me to indorse Prof. Dickson's remarks regarding the classificatory importance of the staminal arrangements.

I have had opportunities of examining sixty-five species, including twenty of those examined by Dickson. Some of these fit into Dickson's three types, but the remainder form three new types of arrangement, which I number 4, 5, and 6 respectively.

Type 4 (Fig. 4) has twenty-five stamens in five festoons of four, and five solitary oppositipetalous.

Type 5 (Fig. 5), with twenty stamens arranged in five festoons of four each.

Type 6 (Fig. 6), with fifteen stamens arranged in five festoons of three each.

In the following list is indicated the type of staminal arrangement in each species examined. The number in front of each species is that in Lehmann's "Revisio." The list contains all those I have examined, with the exception of those previously described by Dickson ("Trans. Bot. Soc.," *loc. cit.*), and some that were doubtful. It is interesting to note here that my specimens of *P. rupestris*, L., showed the arrangement in Type 5, while that of Dickson exhibited his Type 3.

29. <i>P. Ornithopoda</i> , Tausch.—I.	106. <i>P. canescens</i> , Bess.—I.
32. <i>P. Verticillaris</i> , Steph.—IV.	108. <i>P. intermedia</i> , L.—I.
53. <i>P. rupestris</i> , L.—V.	109. <i>P. mollissima</i> , Lehm.—VI.
60. <i>P. bipinnatifida</i> , Dougl.—IV.	112. <i>P. Detomasii</i> , Teu.—III.
60. <i>P. Agrimonoides</i> , M.B.—I.	116. <i>P. kurdica</i> , Boiss.—I.
60. <i>P. Arachnoidea</i> , Dougl.—IV.	<i>P. salisburgensis</i> .—I.
64. <i>P. Chinensis</i> , Ser.—I.	138. <i>P. pilosa</i> , Willd.—IV.
<i>P. Drummondii</i> .—IV.	<i>P. alchemilloides</i> .—I.
69. <i>P. approximata</i> , Bge.—IV.	153. <i>P. Cathaclines</i> , Lehm.—IV.
89. <i>P. Kotschyana</i> , Fenzl.—III.	<i>P. insigne</i> .—I.
91. <i>P. laciniosa</i> , W.K.—IV.	172. <i>P. Hookeriana</i> , Lehm.—IV.
<i>P. erecta</i> .—II.	199. <i>P. Norvegica</i> , L.—VI.
92. <i>P. laeta</i> , Rehb.—IV.	<i>P. Schrenkiana</i> , Rgl.—IV.
<i>P. pedata</i> .—I.	<i>P. Iberica</i> , Hort. Pars.—I.
96. <i>P. desertorum</i> , Bge.—I.	<i>P. Ontopoda</i> , Dougl.—I.
101. <i>P. Fenzlii</i> , Lehm.—I.	<i>P. Buccoana</i> , Clem.—I.
105. <i>P. Collina</i> , Wib.—I.	<i>P. Macnabiana</i> .—I.

Dickson describes the development of the festoons as centripetal, *i.e.* the terminal lobe of the compound stamens—the petal—appears first, then the lateral lobes in basipetal order on either side. The oppositipetalous stamen, when present, develops late. He figures this condition in *P. fruticosa* ("Trans. Bot. Soc.," *loc. cit.*, Fig. 5) which has Type 3 staminal arrangement. In contrast to

this I find in *P. Schrenkiana* (Type 4 staminal arrangement) that the staminal papillæ of each festoon may develop simultaneously.

Fig. 2 shows a young flower of this species bisected in the antero-posterior plane. The epicalcyne, calcyne, and petaline papillæ are developed, but there is as yet no trace of the staminal papillæ. Points to be noted in this figure are the relatively large size of the epicalcyne papillæ at this early stage—a feature which would in some degree support the view of the morphological nature of the epicalyx suggested in this note. Another interesting point is the close relation of the petaline to the epicalcyne papillæ, the former being practically outer growths or branches of the latter.

By the time that the staminal papillæ are all represented the epicalyx and calyx segments are of large size, and, arching inwards, form a funnel-shaped covering over the centre of the flower; the throat of the funnel is closed by a considerable growth of hairs from the inner surfaces of the segments. These hairs develop very precociously, rudiments of them being found at a very early stage on the papillæ. It is only now that the carpellary papillæ begin to appear on the hitherto smooth hemispherical surface of the gynophores. The full details of development of the various types of flowers, and also the discussion as to the nature of the corolla, suggested by its manner of development are reserved for a future note.

Each stamen (Fig. 9) is composed of a free filament tapering towards its apex, where it bears a sub-sagittate anther, the lobes of which converge apically and diverge basally. The filament (Fig. 10) has a single central bundle surrounded by a loose cylinder of parenchyma, the cells of which increase in size, progressing outwards to the epidermis. The anther lobes are two in number in the immature stamens (Fig. 11), and the dehiscence is longitudinal and sub-lateral. The anther wall consists of two layers, an inner fibrous and an epidermis. Where the epidermis dips into the connective between the anther lobes on the posterior and anterior faces, its cells are much elongated radially, and contain a pigment which stains deeply with hæmatoxylin (Fig. 11, *p.*).

Irregularities due to branching in the stamens are by no means uncommon—the middle third of the filament being deeply grooved medially and longitudinally on the posterior and anterior faces, and the two halves diverging as lateral branches in the upper third.

Vascular Supply of the Andrœcium (Fig. 1).—At the base of the toral cup a complete circular stele gives off ten strands, which pass out separately to the epicalycine and calycine segments.

From each epicalycine bundle a petal is supplied, and also the neighbouring stamen. Thus, in the figure which represents the vascular supply of a flower of Type 4, the two parapetalous and the solitary oppositipetalous stamens are so supplied, the former two by strands which branch off on either side of each epicalycine strand near its origin at the central stele; they may arise separately from the epicalycine strands, and then there appear twenty separate strands in all. The sepaline stamens are supplied by strands which come off laterally from the corresponding sepaline strand about half-way up the toral cup. Towards the rim of the cup lateral anastomoses occur between adjacent bundles, and here are situated the nectaries which are thus richly supplied.

Nectaries.—Bonnier ("Annales des Sc. Nat.," Ser. vi. vol. 8) describes the nectaries of *P. Fragaria* and *P. verna*. He states that the nectariferous tissue forms a ring; that it is composed of cells smaller than those of the surrounding parenchyma. The cells have non-granular refringent contents of a uniform yellow colour. This description does not apply to every case, as far as my observations go. A complete nectariferous ring of a chrome-orange colour exists in some species, surrounding the bases of the stamens, and extending internal to them. In other species the nectaries are five in number, lemon-yellow in colour, each consisting of a mamillated convex or shallow concave surface, internal to the bases of the petaline stamens (Fig. 1 and 12, *n.*). Further, Bonnier states that the nectariferous tissue has no distinct epidermis. I find, on the contrary, in many, an epidermis of well-marked columnar epithelial cells. These, however, are early ruptured, and the old nectaries appear to have a ragged surface.

Internal to the nectaries is a broad ring of conical unicellular hairs. These (Fig. 12, *h.*) extend outwards and upwards, and form a more or less efficiently protective barrier over the nectaries.

Gynæcium.—The gynophore (Fig. 12) is somewhat elongated, or broadly club-shaped, constricted at its point of origin from the concave surface of the torus. Its epidermis is either smooth or covered with numerous conical unicellular hairs. Its surface is raised up into blunt papillæ, each representing the point of insertion of a carpel. In consistency it is usually dry, not increasing very much in size on fruiting. *P. Comarum* is an exception to this, and forms a transition to the succulent condition of the *Fragarias*.

Vascular Supply.—The stele, after giving off the ten or twenty strands to the floral envelopes and andrœcium, passes on into the gynophore, where it branches into many small strands, which together form a vascular cone, with a few lateral anastomoses. From the outer surface of this network arise the small twigs supplying the separate pistils. Each twig separately passes obliquely upwards and outwards through the cortex into the carpellary stalk. The pith cells adjoining the vascular network frequently contain numerous rosette crystals of calcium oxalate.

Pistils.—These are, as a rule, very numerous, although occasionally the number is much reduced. Each (Fig. 14) has a small stalk, which is continuous with a very marked ventral keel on the ovary. Ovary, style, and stigma are well demarcated. The ovaries are roughly ellipsoidal, slightly flattened from side to side, with a distinct keel on the ventral side, which is occasionally continued as a less marked ridge around the dorsal border. The style, which arises as a continuation of the ventral keel, originates at different levels in different species, so that the distance between the actual and organic apex of the ovary varies within wide limits; and this is a point that may be of some systematic importance. Thus in some it is slightly lateral, in others more markedly so. In others, again, it may be almost basal, as in *P. rupestris*, which, in this connection, forms a link with *P. Comarum* and the *Fragarias*. Concurrent with this variability in the point of origin of the style are different degrees of anatropism of the ovule, from anatropous

to sub-anatropous conditions when the raphe is hardly marked.

The *Ovarian Wall* is usually white in colour, but becomes brown on maturing. The whole ovary also increases somewhat in size, and the style drops off on fruiting. The ovaries are usually closely packed together on the torus, and entirely concealed by the projecting basal epidermal flanges of the styles.

The ovarian wall (Fig. 3) is composed of three strata of tissue—(1) an outer parenchymatous (*p.*) of a few layers of closely packed cells, the epidermal having cutinised walls; (2) a middle crystallogenous layer (*cx.*) of small, close set, quadrangular, thickish-walled cells, each with a cubical crystal of oxalate of lime; (3) an inner sclerenchymatous stratum composed of (*a*) an outer layer of spindle-shaped fibres parallel to the long axis of the ovary, and (*b*) an inner layer of similar fibres with their long axes transverse to that of the ovary.

The *Style* is continuous with the ventral keel of the ovary, to which it is fixed by a very constricted neck. The length of the style varies, and this may be a feature of systematic importance, as there are well marked long and short styled species. It is composed (Fig. 7) of a cylinder of parenchyma filled with a loose conducting tissue of cells, rich in proteids. The parenchyma cells increase in size outwards to the epidermis, which is composed of larger cells protruding outwards, often in a papillose fashion. These cells are specially noticeable just at the base of the style (Figs. 8 and 14, *b.f.*) near the constricted neck, where they form a sort of basal flange or rosette. They are less well developed on the ventral side, hence appears a ventral groove, which is continuous with a gap in the lip of the funnel-shaped papillose stigma (Figs. 15 and 16). There is usually a more or less well marked constriction just beneath stigma.

All the outer cells of the style contain a peculiar pigment of a light lemon-yellow colour, apparently similar to that already mentioned as occurring in the connective epidermis of the anthers. It resists the usual solvents, gives a brownish precipitate with hydrochloric acid, and dissolves, after a preliminary change

of colour, on treatment with alkalies. It appears similar to that described by Claudel ("Comptes Rendus," 1889) as occurring in the cell cavities of certain seed coats, and as arising from the metamorphosis of the protoplasm.

The *Ovule*, of small size, is more or less anatropous, with the micropyle superior, and the raphe ventral. It is one-coated, and at the chalazal end a pigment having similar properties to that of the styles is developed during maturation.

Vascular Supply of Pistil and Ovule.—The single bundle (Fig. 13) that enters the stalk from the torus bifurcates right and left on passing into the ventral keel of the ovary. It may previously give off a small branch which curves round under the basal end of the ovary, but this is not frequent. The strands pass into the style when they are seen in cross section (Fig. 8, *s.v.*) in the parenchyma, right and left of the median line. They terminate in fan-shaped extremities at the constriction just below the funnel-shaped stigma. From one of the strands in the keel a bundle curves inwards through the funiculus and supplies the ovule. It courses down the raphe, and terminates at the chalaza in a small fan-shaped vascular cup. From the other bundle in the keel a similar branch curves outward over the top of the ovary and forms a small dorsal bundle of varying length.

All these bundles are composed of delicate spiral and annular tracheides, occasionally assuming the appearance of vasa. The phloem, so far as present, is represented by a few delicate-walled elongated cells, rich in proteids.

The summary of floral characters of systematic importance works out somewhat as under. In addition to such features as shape, origin, relative size and position of the epicalyx segments, sepals, and petals—characters already utilised in classification—it is suggested here that the various types of staminal arrangements, as previously partly described by Dickson, and, as further described here, may be of considerable value. Further, the more minute details of the pistils, in addition to the character of the nectaries, whether separate or confluent, are of importance. Thus, the length of the styles, character of the stigma, appearance of the external surface of the

styles, as well as the extent of the ovarian keel, and the attachment thereto of the style, are all diagnostic points.

A comparison of Figs. 17 to 23, which are outline drawings of pistils, will bear out this statement. Thus, *Hookeriana* has a short thick style less than twice the length of the ovary, of fairly uniform diameter throughout its length, expanding suddenly at the apex into a screw-nail head like stigma. *Laciniosa*, again, has the ovarian wall longitudinally ridged and furrowed; a keel all round, most pronounced on the ventral border; a marked basal contraction of the style where it joins the keel. *Rupestris* has a characteristic sub-basal insertion of the style, which is spindle-shaped, contracted at apex and base where it adjoins the stigma and ventral keel of the ovary respectively. The length of the style of the *Kurdica* is characteristic, being many times as long as the ovary, and tapering apically into a discoid stigma, its surface is mamillated. *Viscosa* has a short style again, only about one and a half times the length of the ovary, tapering apically. Further, the ovary has viscid glandular hairs.

EXPLANATION OF THE FIGURES.

1. Diagram illustrating vascular supply of flower.—*ep.* = epicalyx segments; *sep.* = sepal; *pet.* = petal; *n.* = nectary. The supply of one sepal and one epicalyx segment is shown in detail.

2. Left half of a young flower of *P. Schrenkiana*.—*e.* = epicalyx; *s.* = sepal; *p.* = petal. Leitz., Oc. 3, Obj. 3.

3. Transverse section of ovarian wall.—*p.* = outer parenchymatous layer; *c.* = crystallogenous layer; *s.* = schrenchyma layer. Leitz., Oc. 3, Obj. 7.

4, 5, and 6. Diagrams of types 4, 5, and 6 of staminal arrangements. The epicalyx segments are omitted.

7. Half of a transverse section of style in the upper third. Leitz., Oc. 3, Obj. 7.

8. Half of a transverse section of style near its base.—*v.g.* = ventral groove; *b.f.* = swollen epidermal pigment cells forming basal flange; *s.v.* = stylar vessels. Leitz., Oc. 3, Obj. 7.

9. Stamen, showing anther and upper part of filament. Oc. 3, Obj. 2 in.

10. Transverse section of filament. Leitz., Oc. 3, Obj. 7.

11. Transverse section of immature anther.—*p.* = pigment cells. Oc. 3, Obj. 7.

12. Diagrammatic vertical section of flower, showing vascular supply of gynophore and pistils.—*s.* = sepal; *ep.* = epicalyx; *p.* = petal; *st.* = stamen; *n.* = nectary; *h.* = hairs; *p.v.s.* = origin of vascular bundle of petal.

POTENTILLAS

13. Diagram of vascular supply of pistil.—*o.* = ovule; *ov.w.* = ovarian wall; *s.v.* = stylar vessels; *f.v.* = funicular vessel; *c.c.* = chalazal cup; *d.v.* = dorsal vessel.

14. Pistil showing basal flange.—*b.f.* formed by expanded epidermal cells; *v.k.* = ventral keel.

15. Ventral, and 16, profile view of stigma, showing the ventral groove.

17-23. Outline drawings of pistils.—17 = *laciniosa*; 18 = *viscosa*; 19 = *kurdica*; 20 = *Hookeriana*; 21 = *Fenzlii*; 22 = *approxinata*; 23 = *rupestris*.

THE RELATION BETWEEN THE LENTICELS AND ADVENTITIOUS ROOTS OF *SOLANUM DULCAMARA*. By JAMES A. TERRAS, B.Sc., Lecturer on Botany, Edinburgh. (With Plates.)

(Read 11th January 1900.)

The existence of a definite relationship between adventitious roots and lenticels was recognised for the first time in 1826 by De Candolle (3), as the result of an investigation into the modes of rooting exhibited by a number of cuttings taken from the most varied species of woody plants; and subsequent authors, though differing widely as regards the degree of interdependence of these structures and the functional causes which underlie the connection between them, have never denied the primary fact that the great majority of those lateral adventitious roots, which under favourable conditions are found growing out from the surface of many woody stems, take their origin below lenticels.

Stahl (7), in his classical work on the development and anatomy of lenticels, cited *Solanum Dulcamara* as a species in which nearly all the adventitious roots arise below lenticels, but attempted no explanation.

Fourteen years later, Beijerinck (2) called attention to the remarkably large number of root rudiments occurring on the stem of this plant, and to the facility for vegetative propagation which it in consequence possesses, but made no reference to the connection between these roots and the lenticels, which, indeed, he scarcely mentions.

Klebahn (4), in 1884, figured a lenticel of *S. Dulcamara*, but made no mention of the subjacent root, and the first connected account of the relationship in which these two