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ANNALS

OF THE

ROYAL BOTANIC GARDEN, CALCUTTA.

Vol. I.

APPENDIX.

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...ICAL SURVEY

SOME

NEW SPECIES OF FICUS

FROM NEW GUINEA.

BY

GEORGE KING, M.B., LL.D., F.R.S., F.L.S.,

Superintendent, Royal Botanic Garden,

CALCUTTA.

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No. 3817

Urostigma.

Ficus HESPERIDIIFORMIS, *King in Journ. As. Soc. Bengal* lv. *pt* ii. 401.

A tree; glabrous in all parts except the stipules, "which are minutely tomentose externally; young branches hollow, thick, marked with annular scars. Leaves coriaceous, alternate, broadly elliptic-oblong, gradually tapering towards the apex, which ends in a short rather blunt point; the base rounded, edges entire; lateral primary nerves very numerous (40 or 50 pairs), running nearly at right angles from the thick prominent midrib and anastomosing about *1 in. from the edge; secondary nerves and reticulations minute but distinct; the petiole from \ to ^ as long as the blade; stipules very large, coloured, convolute, minutely tomentose on the outer, smooth on the inner surface; length of blade and of stipules 6 to 9 in.; petioles 2'5 in. to 4*5 in. Receptacles large, axillary, solitary, pedunculate) globose, smooth, apparently without basal bracts, about I'd in. in diam., the walls very thick. Male flowers numerous, pedicellate; anther single, sub-sessile, ovoid, its walls thick and cartilaginous, the dehiscence lateral; perianth gamophyllous with 3 oblong blunt segments. Gall-flowers with hard, crustaceous, 3-sided ovary, thick short pedicel, and no perianth other than the long, linear, subulate scales which spring from the walls of the receptacle between the flowers. Fertile female flowers not seen.

New Guinea,—ST. *0. Forbes,* No. 737.

The material in my possession is not very abundant, and I have not had the advantage of seeing Mr. Forbes's field notes. I presume this is a tree. The leaves and stipules at once recall to mind those of *F. elastica.* But the leaves of this are larger, and the stipules are tomentose externally. The receptacles are quite different from those of *elasOca_f* being greatly larger and of a globular, not an ovoid, shape. When dry, the receptacles a good deal resemble small oranges.

PLATE 226.—*F. hesperidnformis,* King. 1, branch with young leaves and mature receptacle; 2, fully-grown leaf—*of natural size;* 3, scale from inner wall of receptacle; 4, male perianth; 5, anther; 6, the same opened; 7, gall-flower: *enlarged.*

Ficus EDELFELTII, *King in Journ. As. Soc. Bengal* lv. *pt.* ii. 402.

A tree; the bark of the young shoots pale and slightly puberulous; all the other parts glabrous except the midribs of the leaves and the receptacles. Leaves alternate, thinly coriaceous, shortly petiolate, from oblong to obovate-elliptic, gradually narrowed to the rounded 5-nerved base; the apex rather suddenly contracted to a short blunt acumen; the edges entire and slightly undulate; primary lateral nerves about 9 pairs, prominent on the lower surface and forming bold intramarginal arches; the midrib prominent, sparsely adpressed-pubescent; the rest of the lower surface glabrous and shining; the minor nerves and reticulations strongly marked; upper surface dull, darker than the lower; length of blade 6 to 8 in.; width 3 to 3*25 in.; petioles '5 in. long; stipules slightly shorter than the petiole, lanceolate, convolute. Receptacles axillary, in pairs, pedunculate, globular, with a projecting cylindric pubescent umbilicus; the sides pubescent when young, nearly glabrous when adult, from '6 in. to '75 in. in diam.; basal bracts 3, small, reflexed; peduncle about •1 in. long, tomentose. Male flowers only near the mouth of the receptacle, sessile; the stamen elliptic, on a short thick filament; perianth of 5 narrowly semi-lunar pieces. Gall-flowers with a globular smooth, thin, naked ovary and a short lateral style; the perianth like that of the male. Fertile female flower with an ovoid, rather flattened, minutely tuberculate achene, and a filiform lateral style much longer than the ovary; the stigma triangular; perianth of 4 broadly semi-lunar pieces.

New Guinea,—*H. 0. Forbes,* No. 59, and probably also 409, of which I have not complete specimens.

In foliage this species much resembles the Indian *F. nervosa,* Heyne; but the receptacles of this are much larger. Its nearest ally is, however, *F. pubinervis,* var. *Teysmanni,* which it almost exactly resembles in the form, texture, and nervation of its leaves. The flowers, however, of the two differ, and I have no doubt they are distinct species.

PLATE 227.—*F. Edelfeltii,* King. Fruiting-branch. 1, stipules ; 2, base of receptacle—*of natural size;* 3, male flower; 4, gall-flower ; 5, fertile female flower: *enlarged.*

Ficus LAWESII, *King in Journ. As. Soe. Bengal* lv. *pt.* ii. 403.

A tree; all its parts quite glabrous; the bark of the young shoots pale and shining. Leaves petiolate, thickly membranous, ovate-oblong or narrowly elliptic, entire; the base rounded, 3-nerved; the apex gradually narrowed to a very short blunt point; lateral primary nerves diverging from the bold midrib at a wide angle, about 10 pairs, not very prominent on either surface ; the reticulations small and rather distinct on the lower surface; both surfaces quite smooth, but rather dull when dry; length of blade 5 to 6 in.; width 2*5 in.; petiole 1 in. to 1*25 in. ; stipules narrowly lanceolate, convolute, rather more than half as long as the petiole. Receptacles crowded near the ends of the branches, in pairs, sessile, cylindiico-globose, #5 in. in diam., contracted at the base into a short thick pseudo-stalk; umbilicus composed of 3 large, thick, smooth triangular scales, the sides smooth; basal bracts coalescing into an irregular ring. Gall-flowers sessile; the ovary prismatic, conical, smooth ; style and stigma absent. Male and fertile female flowers unknown.

New Guinea,—*H. 0. Forbes,* No. 85,

From its general *fades,* I have no doubt that this is a *Vrostigma* near *nervosa.* The receptacles, however, in the only two specimens I have seen are diseased, and only the gall-flowers can be distinguished.

I have named this after the Rev. W. G. Lawes, one of the devoted band of missionaries settled on the south-eastern coast of New Guinea who have done so much in the way of collecting.

PLATE 228A.—*F. Lawesii,* King. Fruiting-branch. 1, stipules; 2, apex of receptacle—*all of natural size.*

Ficus CASEABIOIDES, *King in Jonrn. As. 80c. Bengal* lv. *pt.* ii. 403.

A glabrous tree. The leaves on long petioles, thinly coriaceous, alternate, entire, broadly ovate-elliptic, tapering much to either end; the base acute, 3-nerved; the apex suddenly and shortly triangular-acuminate ; lateral primary nerves 8 to 10 pairs, nearly at right angles to the midrib and, like it, strongly marked on the under surface, which is minutely tuberculate-tesselate; length of blade 5 to 6[a]5 in.; breadth 2*75 in. to 3*25 in.; petiole 1*5 in.; stipules lanceolate sub-convolute, '6 in. long. Receptacles axillary, in pairs, on long slender peduncles, •5 in. in diam., depressed globular with a slight stalk-like constriction at the base, smooth; basal bracts 3, minute; peduncles #75 in. long. Male flowers sessile; the single anther broadly ovate, sub-sesaile; the perianth of 3 obovate pieces. Gall-flowers sub-sessile or pedicellate; the ovary smooth, with thick crustaceous walls; the style short, lateral; the stigma inf undibulif orm; perianth of 4 or 5 oblong pieces which closely invest the ovary. Female flowers like the galls, but with a shorter, more globose, ovary and a longer style: all three kinds in the same receptacle.

New Guinea,—*H. 0. Forbes,* No. 568.

The leaves of this a good deal resemble those of *F. easearia,* Mull, but the structure of the flowers is different. The affinities of this in the section *Urostigma* are with *nervosa.*

PLATE 228B.—*F. casearioides,* King. 3, fruiting-branch; 4, base and apex of receptacle—*of natural size ;* 5, male flower ; 6, gall-flower ; 7, fertile female achene * *enlarged.*

Synoecia*

Ficus SGRATCHLETANA, *King in Journ. As. 80c. Bengal* lv. *pt.* ii. 404.

Scandent, glabrous except the receptacles which are minutely sub-tomentose. Leaves petiolate, coriaceous, entire, narrowly elliptic-oblong, gradually tapering to either end; the base minutely cordate, 3-nerved ; the apex with a short blunt point; under surface tesselate ; primary lateral nerves 5 or 6 pairs, prominent beneath, as is the midrib ; length of blade 5 to 7 in.; width 1*75 in. to 2*25 in.; petioles 1 in. to 1*5 in. long ; stipules subulate, convolute, about *5 in. long. Receptacles axillary, solitary, pedunculate, ovoid-globose, minutely sub-tomentose, with a prominent umbilicus, about 1 in. in diam.; basal bracts 3, small. Fertile female flowers pedicellate; the perianth of 4 linear pieces; ovary ovoid-elliptic; the style lateral; stigma large, bicrural when young, truncate when adult from the absorption of the arms. Neuter flowers mixed with the females all over the receptacle, pedicellate; the perianth of 4 lanceolate pieces. Receptacles containing male and gall-flowers not seen.

New Guinea,—*H. 0. Forbes,* No. 900.

This is well distinct from any other species of this group. Its nearest ally is *F. apiocarpa,* Miq.

PLATE 229A.—*F. Scratchleyana,* King. Fruiting-branch—0/ *natural size.* 1, young fertile female flower ; 2, ripe achene of fertile female ; 3, neuter flower : *enlarged.*

Sycidium.

Ficus ARMITI, *King in Journ. As. Soc. Bengal* lv. *pt.* ii. 404.

A climber; the young shoots covered with short, buff-coloured tomentum. Leaves alternate, shortly petiolate, membranous, ovate-lanceolate, with a long acuminate apex; the base rounded or sub-cordate, 5 to 7-nerved; the edges entire; primary lateral nerves 5 to 7 pairs, diverging from the midrib at rather a wide angle; lower surface minutely tuberculate, hispid especially on the midrib and nerves, the longer hairs with black enlarged bases; upper surface scabrid, the midrib minutely hispid; length of blade 2*5 in. to 3 in.; breadth 1*25 in.; petioles *2 in. long, tomentose; stipules, 2 to each leaf, subulate, rather longer than the petioles, tomentose at first, but ultimately glabrous. Receptacles axillary, solitary, pedunculate, sub-globular, with rather a prominent umbilicus, shortly hispid-tomentose when young, glabrescent when mature, #2 in. to *25 in. in diam.; basal bracts none, but a few irregular, broad, fleshy bracts along the sides; peduncles slender, about *2 in. long, tomentose. Male flowers numerous near the mouth of the receptacle; the perianth of 3 lanceolate pieces; anther single, broadly ovate, on a long stout filament. Gall-flowers with a pedicellate gamophyllous perianth, which is deeply cleft into 4 linear curving lobes, which embrace the ovoid, smooth, shining ovary; style lateral, from near the apex of, and half as long as, the ovary; stigma infundibuliform. Female flowers unknown.

New Guinea,—*H. 0. Forbes,* No. 609.

This species approaches *F. ampchs,* Burm., but its leaves are more inclined to be cordate at the base and acuminate at the apex, and they are less scabrous and more hairy on the under surface; while the receptacles are larger, more hairy when young, and on longer peduncles, than in that species.

I have named this after Mr. Armit, of the *Argus* Expedition for the exploration of New Guinea.

PLATE 229B.—F. *Armiti,* King. 4, fruting-branch; 5, stipules; 6, base and apex of receptacle—*of natural size;* 7, male flower; 8, perianth of gall-flower; 9, achene of same: *enlarged.*

Covellia.

Ficus CHALMERSII, *King in Journ. As. Soc. Bengal* lv, *pt.* ii. 406.

A tree; the young shoots slightly swollen at the nodes; the bark dark brown with short, pale, adpressed-hispid hairs. Leaves alternate, thickly membranous, ovate-lanceolate to dvateoblong, tapering gradually to the slightly unequal, bluntish or sub-acute, 3-nerved base, and to the sharply, but shortly acuminate, apex; the edges entire or obscurely and remotely sub-serrate; primary lateral nerves about 7 pairs, minutely adpressed-hispid on both surfaces; the remainder of the lower surface of the leaf glabrous, of the upper surface minutely adpressed hispid; length of blade 5 or 6 in.; petiole about '5 in. long, adpressed-hispid; stipules, in pairs, lanceolate, glabrous except a few stiff hairs near the base externally, -5 in. long. Receptacles on short woody racemes from the stem and larger branches, pedunculate, in pairs, when young broadly pyriform with concave apex and much depressed umbilicus, smooth, #75 in. or upwards in diam.; basal bracts 8, broadly triangular, united into a cup; peduncle thick, about *25 in. long. Female flowers (when young) narrowly ovoid elliptic; the style short, thick, terminal, with a dilated discoid tubular stigma; the perianth gamophyllous, half as long as the ovary and closely applied to it. Ripe female, male, and gall-flowers unknown.

New Guinea,—*H. 0. Forbes,* No. 100.

A' species near *F. brachiata,* King; but not so glabrous, and with its receptacles borne on much shorter branches than in that species. Named after the Rev. J. Chalmers, the intrepid missionary explorer of New Guinea.

PLATE 230A.— *F. Chalmersii,* King. 1, leaf twig; 2, fruiting-branch; 3, receptacle—*side view ;* 4, apex of receptacle ; 5, stipules—*of natural size;* 6, young male flower: *enlarged.*

Ficus BERNAYSII, *King in Journ. As. Soc. Bengal* lv. *pt* ii. 406.

A tree ? the young shoots fulvous-tomentose. Leaves alternate, shortly petiolate, membranous, inequilateral, obovate-elliptic, tapering gradually from above the middle to the bluntish, very unequal, obscurely 5-nerved base, and rather suddenly to the shortly acuminate apex; the edges minutely serrate; the whole of the under surface shortly fulvous-tomentose ; primary lateral nerves 7 pairs; upper surface shortly adpressed-hispid, tomentose on the midrib and nerves; length of blade about 7 in.; petioles under #5 in.; stipules tomentose externally, glabrous internally, convolute, *5 in. long. Receptacles on long peduncles, in short crowded panicles, from the stem and larger branches, puberulous, sub-globose! about •25 in. in diam., contracted at the very base into a short pseudo-stalk at the junction of which with the peduncle proper are 3 small triangular basal bracts; peduncle proper nearly *5 in. long. Young female flowers with a flattish, ovoid, smooth ovary; the style nearly as lqng as the ovary, lateral, curved, hairy; the stigma cylindrio; perianth gamophyllous, very short, covering only the stalk of the ovary. Ripe female, male, and gall-flowers unlyiown.

New Guinea,—*H.* 0, *Forbes,* No. 625.

A species which, in the form and arrangement of its receptacles, resembles *F. condense* . King, and in its leaves approaches *F. stipata,* King, *F. fasciculate* King, and *F. Forbesli,* King.

Named in honour of Mr. L. Bernays, of Brisbane, whose efforts for the exploratiou of New Guinea and for the development of his own Colony of Queensland are so well known.

PLATE 230B.—i*. *Bernayiii,* King, 7, leaf twig; 8, cluster of young receptacles; 9, base and apex of young receptacles—*of natural size;* 10, youug female flower: *enlarged.*

Eusyce.

Ficus PANTONIANA, ***King in Journ. As. Soe. Bengal*** **Iv.** ***pt.*** **ii. 407.**

A glabrous climber. Leaves alternate, shortly petiolate, coriaceous, almost exactly oval or ovate-oblong, entire; the apex slightly acute; the base rounded or sub-cordate 3-nerved; primary lateral nerves 4 pairs, rather prominent on the lower surface, which has wide, obscurely tesselate reticulations; length of blade 3 or 4 in.; width 1*5 in. to 2 in.; petiole rather under *5 in.; stipules ovate-acute, glabrous, *3 in. long. Receptacles in pairs from the axils of the leaves, but mostly from the scars of fallen leaves, smooth, globular, '4 in. in diam., produced at the base into a pseudo-stalk nearly -5 in. long, at the junction of which with the peduncle proper are 3 minute bracts. Female flowers pedicellate; the perianth deeply 4-cleft, the lobes shorter than the ovate-oblong, smooth, pale-edged ovary; style thick, lateral; stigma widely infundibuliform. Male and gall-flowers not seen.

New Guinea,—*H. 0. Forbes,* No. 185.

I have not seen the receptacles of this which contain the male and gall-flowers; but I put it into this section with some confidence from its resemblance, in externals as well as in the structure of the female flowers, to *F. distieha,* Bl.

I have named it in honour of Mr. J. A. Panton, a distinguished Australian explorer.

PLATE 231 A.—*F. Pantoniana,* King. 1, leaf twig; 2, piece of a fruiting-branch; 3, base and apex of receptacles—*of natural size* ; 4, male flower: *enlarged.*

Ficus BAETJEKLENI, ***King in Journ. As. Soe. Bengal*** **lv.** ***pt.*** **ii. 408.**

Scandent; the young shoots puberulous. Leaves coriaceous, shortly petiolate, ovate-oblong or elliptic-lanceolate; the base rounded or subcordate 5-nerved(2 of the nerves minute); the apex gradually narrowed to a short point; the edges entire; primary lateral nerves 4 or 5 pairs, very bold (as is the midrib) on the under surface which is uniformly covered with very short, soft, brown tomentum; upper surface minutely tuberculate; length of blade about 7 in.; petiole *4 in.; stipules convolute, pilose externally, rather longer than the petioles. Receptacles axillary, pedunculate, solitary or in pairs, depressed-globose, nearly 1 in. in diam., contracted at the base into a short pseudo-stalk at the junction of which with the peduncle proper are 3 broadly triangular basal bracts; peduncle proper -25 in. long, tomentose. Female flowers with a perianth of 4 distinct fleshy pieces, which are shorter than the narrowly ovoid, smooth ovary; style slender, terminal; stigma halbert-shaped. Male and gall-flowers not seen.

New Guinea,—IT. *0. Forbes,* No. 378.

Tlbis has a general resemblance to *F. reeurva,* Bl. in the form and venation of its leaves and in the perianth of the female flowers. It is, however, well distinct by the larger size of all its parts, but especially of its receptacles which are ten times as large as those of *reeurva,* besides being pedunculate and of a different shape. This also resembles *lasioearpa,* Miq.

I have named this after M. Baeuerlen, of the expedition sent by the Geographic Society of Australasia for the exploration of New Guinea.

PLATE 231B.—*F. Baeuerleni,* King. 5, fruiting-branch; 6, stipules—*of natural size ;* 7, young male flower: *enlarged.*

Ficus RHIZOPHOREPHYLLA, *King in Journ. As. Soc. Bengal br.pt.* **ii. 410.**

Scandent; all parts glabrous. The leaves thinly coriaceous, on long petioles, narrowly elliptic, tapering equally to either end; the edges entire, cartilaginous, and slightly recurved when dry; the midrib keeled, and very prominent on the under surface; primary lateral nerves 12 pairs or upwards, sub-horizontal, scarcely visible on either surface; under surface minutely tesselate, dull; upper surface very smooth, shining; length of blade 3'5 in.; breadth 1-5 in.; petiole 1-3 to 1'8 in. long; stipules linear-lanceolate, glabrous, as long as, or longer than, the petioles. Receptacles crowded near the apices of the branches, in pairs, shortly pedicellate, globular, very minutely tuberculate, '25 in. in diam. Female flowers on strong cartilaginous prismatic peduncles thicker than the prismatico-conical smooth ovaries; style from the base of the ovary which it slightly exceeds in length, straight, erect; perianth of 3 linear pieces which rise from the margin of the peduncle, Male and gall-flowers unknown.

New Guinea,—*H. 0. Forbes,* No. 578.

Without having seen its male and gall-flowers, I put this species without hesitation into the section *Eusyce,* on account of its resemblance to *F. olewfoiia,* King, a species from Sumatra which has leaves very like this in texture and venation, but is smaller in all its parts, and especially in its stipules. A farther indication of affinity is found in the fact that the gall-flowers of *olecefolia* and the fertile females of this species have similar prismatic ovaries. This in foliage also resembles the Australian *F. eugenioides,* Mull., which, however, has very different female flowers, and which moreover is monoecious and falls into the section *Urostigma.* The leaves of this are of a pale greenish yellow when dry; in shape and venation they much resemble those of *Rhizophora conjugate.* Linn.

PLATE **232.—*F. rhizophorcephylla*, King. 1, fruiting-branch; 2, stipules; 3, base and apex of receptacles—*of natural she;* 4, fertile female flower: *enlarged.***

INTRODUCTION

TO

DR. CUNNINGHAM'S MEMOIR.

IT has been assumed in the following paper that the nature and arrangement of the flowers in the receptacles of dioecious species of figs are familiar to the reader; but in case they may not be so, it may be well to give a brief description of them. The receptacles consist of hollow, flask-shaped or spheroidal bodies, the cavities of which are bounded by solid walls save at their apparent apices, where these are replaced by masses of the appressed and interlocking bracts of the so-called ostioles. In *F. Rozburghii* and many other species the arrangement of these bracts is such as practically to convert the interior of the receptacle into a closed cavity. In this species two distinct kinds of receptacles are to be met with, each kind being confined to particular trees. In one of these two forms of flowers are present, viz. *{a)* true male flowers situated in the neighbourhood of the ostiole and capable of producing pollen, and (5) modified female or gall-flowers, which never produce seed, but within the ovaries of which in very many cases the ova of certain species of insects are deposited and undergo evolution. In the second kind of receptacles no male flowers are present, and the floral surface of the cavity is occupied by true female flowers, which never contain the ova or embryos of insects, but which are capable of producing fertile seeds. The perfect evolution of both male and true female flowers in *Ficus Rozburghii,* and probably in other species also, is dependent on the access of the fig-insects to interior of the receptacular cavity. Should access fail to occur, both forms of flowers abort without the formation of pollen-grains in the one case or seeds in the other, and the access of the insects is thus as necessary for the perfect evolution of the normal male and female flowers as it is for that of the modified female or gall-flowers with their contained ova and insect-embryos.

ON THE

PHENOMENA OF FERTILIZATION

IN

FICUS ROXBURGHII, WALL.

BY

D. D. CUNNINGHAM, M.B., F.L.S., &c,

Surgeon-Major, Bengal Army.

Sources of materials.

THE trees from which specimens of receptacles were obtained were seven in number, five of which, including four males and one female, are in the Royal Botanic Garden, Calcutta,; while the remaining two, one male and one female, are in the Zoological Garden, Alipore. In so far as the specimens in this region are concerned, the tree is strictly dioecious, one set of individuals invariably only producing receptacles containing gall-flowers and males, the other only producing receptacles containing true female flowers.

General phenomena of fruiting of Ficus Roxburghii.

As far as I have as yet been able to ascertain, two annual crops of receptacles, as a rule, come to maturity on the male trees. The precise period of maturation differs in different trees, but in all cases lies either in the cold weather or in the first half of the hot weather—that is, between the beginning of November and the middle of May. In two of the trees in the Botanic Garden maturation occurs in the end of November and the beginning of December, and again in February and March. In the other two maturation occurs somewhat later, apparently in December, and again in the end of April and early part of May. Hardly any new receptacles make their appearance during the hot weather—April to the middle of June—and these with any immature ones belonging to the cold weather appear, as a rule, to dry up and abort without having ever reached the stage at which the fig-insects, whose access is essential to true maturation, enter them. Some time after the onset of the rains in June new receptacles begin to appear again in numbers, representing the crops maturing in the early, part of the cold weather. These statements must, however, be taken very generally, as great differences in regard to the numbers of receptacles developed at different periods appear to occur from year to year, and occasional buds may become developed at almost any time.

Much more definite data are available in regard to the duration of any crop which comes to maturity. The entire period from the first appearance of the buds of a crop of gall-receptacles to the escape of the fig-insects ranges between four and five months, varying somewhat according to the character of the season; two months intervening between their first appearance and the attainment of the stage of development rendering them suitable for the access of the insects, and two to three months from that time until full maturation takes place. Maturation proper is, however, dependent on the access of insects and should this fail to take place, the receptacles dry and fall about a month after they were ready to be entered.

It is very difficult to determine the question of the number of annual crops of receptacles which mature on the female trees, as only a small number ever do mature even after they have been effectively visited by the fig-insects, due to the fact that in a large majority of cases they are attacked by the larva of some species of Lepidopterous insect, which after spending the earlier portion of its existence in devouring the flowers, ultimately Scapes by perforating the ostiole, and thereby causes escape of the receptacular fluid and consequent drying up and fall of the figs. In the case of the female tree in the Botanic Garden, from which alone normal ripe receptacles have been as yet obtained there is only one site where they as a rule occur. This is at the very base of one of the stems where the fertile twigs are actually on the ground and the receptacles are crowded together among the grass and weeds, which must apparently serve to protect them from the visits of the winged parents of the grubs. Here two, if not more, crops certainlv mature in the course of the year-one in the end of February and March the other in the latter half of May and beginning of June. The duration of any crop which successfully matures appears to be almost the same as in the case of the male receptacles a period of from one to two months intervening between eruption of the buds and attainment of the stage for the access of insects, and two to three months between that and the occurrence of full maturation. For example, on the 10th of March 1888, the fertile twigs on the toe.in the Botanic Garden were beginning to be covered with buds, some of them having already attained the size of hazel-nuts; on the 26th March some receptacles were ready for insects; on the 6th April some had already been entered; and on the IS May ripe receptacles were present. The previous crop has a somewhat longer duration no doubt due to the lower temperature to which it is exposed, and receptacles which are entered by insects in the end of November do not ripen until the end of February

The eruption of new crops of receptacles sometimes occurs along with that of new leaves, but there is no necessary association of the two events. There are two periods of defoliation-the first and most complete fall taking place in the latter part of thTcold weather in February, and a second one, which varies in degree with the nature of the s e l n occurring during the second half of the hot weather; the fall increasing in amount with the heat and dryness of the season. During the past season an eruption of a new crop of receptacular buds occurred simultaneously with the spring change of leaf on the female tree in *e Botanic Garden, whUe none occurred at the same time on any of the male ones, in two of which at all events the previous crop of receptacles dated from the middle of the cold weather, when no change of leaf occurs.

The receptacles of Ficus Roxburghii.

In passing on to a description of the receptacles no mere general data are sufficient, and it is necessary to give details in regard to the condition of both female and male or gall* receptacles at different stages of development, and in relation to the fact of the fig-iasects gaining access to them or failing to do so. We have thus to consider the features presented by each class of receptacles under the following headings:—

1. Characters at the stage when they are ready for the access of insects.
2. Characters of receptacles after insects have attained access, but before maturation.
3. Characters of mature receptacles to which insects have gained access.
4. Characters of mature receptacles to which insects have not gained access. Such receptacles are divisible into two varieties—

   (a) One in which no appreciable development has occurred after the flowers have reached the condition which they normally present at the time for access of insects.

   (b) One in which a certain amount of evolution of the male flowers or of some of the true female flowers has occurred beyond that condition.

I.—MALE OR GALL-RECEPTACLES.

A.—Characters at the stage when they are ready for the access of insects.*

The following are the measurements obtained from a receptacle of average dimensions:—

External diameter	.2"'O
Thickness of wall	.0"'25
Thickness of plug of ostiolar bracts	.0**30
Diameter of area in centre of ostiolar aspect of cavity occupied by empty bracts	.0"-49
Breadth of surrounding zone of male flowers	.0"-21
Breadth of peripheral zone of gall-flowers on ostiolar aspect of reoeptaoular cavity	.0*-24
Depth of gall-flower stratum	.0"·06

The ostiole is at this time closed by a firm, solid plug of closely appressed ostiolar bracts, and the centrul area of the ostiolar aspect of the cavity is thickly clothed with others (Plate IV, figs. 21, 22). Around this bracteal area a narrow zone of true male flowers is situated, and external to it the continuous stratum of gall-flowers which lines all the rest of the receptacle commences (Plate IV, fig. 22). The area of bracts and male flowers forms a central concave boss on the ostiolar aspect of the cavity, the concavity mainly being due to the fact that the male flowers and their bracts stand erect, while the empty bracts are situated on an inclined basis, and become more and more oblique as they pass onwards along the course of the ostiolar channel; in the central portion of which they are arranged horizontally (Plate IV, figs. 21, 22, 23). In passing from without inwards along the course of the ostiolum, we first meet with bracts directed upwards and inwards in varying degrees of obliquity, next with horizontal ones, and then with a series which are directed downwards and inwards towards the cavity; the inclination becoming steeper and steeper internally until it becomes almost vertical at the internal limit of the zone of male flowers (Plate IV, fig. 21). The central bracteal area is of a pale yellowish-green colour, the zone of male flowers and their enclosing bracts is whitish, and the rest of the surface of a pale pink, or occasionally of a bright rose colour, due to the pigmented cells of the styles and stigmata of the gall-flowers. The cavity of the receptacle at this stage is devoid of fluid, the internal surface of the wall smooth and even, and the ovaries of the gall-flowers arranged in a single row, or at utmost in two rows, due to some of them being sessile and others shortly pedicellate (Plate IV,,figs. 22, 25).

B.—Characters of gall-receptacles after access of insects, but before maturation.

The following data show the conditions present at various periods prior to maturation:—

1. Receptacle 16 days after access of insects to the cavity-

External diameter.	.2*2
Thickness of wall.	.0*24
Depth of gall-flower stratum.	.0*19

The inner surface of the wall was no longer quite smooth, but had begun to show a series of elevations and depressions, and the ovaries of the gall flowers were already arranged in three or four superimposed strata. The cavity was still empty.

2. Receptacle to which insects had recently gained access—

External diameter.	.2**5
Diameter of area of male flowers and ostiolar bracts. . . . . . .,	0*91
Breadth of zone of male flowers.	.0"-18
Depth of ostiolar plug.	.o*38
Depth of the solid portion beneath the level where the bracts were loosened, due to the corpses of insects interposed between them . .	0*16
Average thickness of the walls.	.0*39
Thickness of stratum of gall-flowers.	.o*27

In this case the male flowers were present in three or four rows. They had emerged from their sheathing bracts, and the lobes of the outer perianth were beginning to separate. The inuer surface of the stratum of gall-flowers was no longer composed of the stigmata, but of the summits of the projecting cupolas of the ovaries, and the cavity of the receptacle was full of fluid. The colour of the interior was faint madder-brown, due to the deeply tinted stigmata and slightly coloured ovaries*

3. Receptacle at a considerable period after the access of insects-

External diameter.	.gv.g
Diameter of area of ostiolar bracts in the cavity.	.0*33 x 0*58
Breadth of zone of male flowers.	.0*3
Breadth of peripheral zone of gall-flowers on ostiolar face of the oavity .	0*54 to 0*4
Thickness of wall of receptacle.	.0^37
Depth of stratum of gall-flowers. . . . .\ \ . .	0*35

The peripheral area of gall-flowers around the zone of male flowers now projected above the level of the latter in place of forming a groove. The cavity was full of fluid.

4. Receptacle at a considerable period after the access of insects—

Diameter of area of ostiolar bracts.	.0*-35x0"*2
Breadth of zone of male flowers.	.0*24
Breadth of peripheral prominent area of gall-flowers around the male flowers on the ortiolar face of the oavity.	.(T-47 to 0*-51
Thickness of receptaoular wall.	.0"-37
Depth of stratum of gall-flowers.	.0*3

The cavity was full of fluid and the internal surface of the wall uneven.

5. Receptacle almost mature; weight 387 grammes—

Depth of stratum of gall-flowers in some parts.	.0*61

The cavity contained 20c.c. of a reddish-brown alkaline fluid full of fine, suspended particles, almost transparent when filtered, and with a specific gravity of 1116·3. The stratum of gall-flowers was very thick, and in some places contained 8 or 9 tiers of superimposed ovaries.

6. Receptacle almost mature—

Depth of ostiolar plug.	.0**66
Diameter of area of male flowers occupying the centre of ostiolar face of the oavity.	.0*84
Breadth of peripheral area of gall-flowers around the male flowers . . .	0*8
Thickness of the reeeptacular wall.	.0*63

Cavity full of fluid. Ostiolar scales now all convergent, and no longer visible from the interior unless after pushing outwards th^ convergent flowers of the now centrally situated male area, Interior of the wall of the receptacle very uneven, being covered by* a series of elevations and depressions (Plate IV, fig. *26).*

C.—Characters of mature gall-receptacles to which insects have gained access.

The following are the data regarding a specimen in this condition:—

External diameter.	.3*75
Diameter of prominent mass of male flowers in the centre of the ostiolar face of the oavity.	.0*87
Diameter of ostiolar orifioe internally.	.0"-4
Breadth of area around it occupied by bases of male flowers	0*27
Thickness of ostiolar plug of bracts.	.0*8
Breadth of peripheral area of ostiolar face of the oavity oooupied by gall-flowers.	.0*7 to 1*06
Thickness of receptaoular walls.	.0*46 to 0*58
Depth of stratum of gall-flowers.	.0*5

The reeeptacular cavity was empty, and its walls very uneven. The male flowers had their stamens widely expanded, and formed & conspicuous rounded elevation on the centre of the ostiolar space. It was only on separating the central flowers that the ostiolar orifice became visible. It was firmly closed by ostiolar bracts, even the superficial of them being very obliquely inclined to one another, and the deeper ones lying horizontally.

On comparing the data regarding receptacles in various stages of maturation subsequent to the access of insects, it is very evident that, besides very great general increase in bulk (Plate I, figs. 1, 2), there is a distinct tendency towards an unfolding of the receptacle. The ostiolar orifice at the period of access of insects is normally more Or less distinctly craterform, with the larger opening directed towards the cavity, and the sloping surfaces around it covered by somewhat oblique and almost erect bracts (Plate IV, fig. 21). In mature receptacles, on the other hand, the widest portion of the orifice lies externally, and the sides of the deeper portion, in place of being sloped, are almost vertical, the change in their inclination having necessarily induced one in that of the bracts springing from their surfaces (Plate I, fig. 2). The margins of the orifice are in fact turned outwards as maturation advances, the process causing a change in the direction of the bracts and increasing the depth of the plug. The main determinant of the change is the excessive growth of the gall-flowers in the peripheral area of the ostiolar aspect of the cavity, for, while the basal area of the male flowers remains almost unaltered,, that of the gall-flowers is very greatly increased, and the accumulation of dense masses of enlarged ovaries in the deeper part of the concavity where the ostiolar and lateral faces of the receptacular cavity meet must evidently tend to force the former outwards, or, in other words, must tend to unfold the receptacle. The process causes little or no alteration in the dimensions of the internal orifice of the ostiolar channel, but tends to render the dimensions of the latter more or less uniform throughout. The concealment of the ostiolar bracts by the male flowers in the mature receptacles is thus not due to any appreciable extent to any contraction of the circular zone on which the latter are situated, but merely to change of direction in its contours in association with great growth in the individual flowers.

The increase in thickness of the stratum of gall-flowers is enormous. This is mainly due to the fact that the increase in bulk of the ovaries is altogether in excess of that of the surface to which the pedicels of the flowers are attached, the result being that it is no longer possible for them to find space arranged in a single or double layer as they originally were, and that they have to be packed away in many superimposed strata (Plate I, fig. 2; Plate IV, figs. 23, 26). Even this, however, would not give sufficient space were it not that the surface of attachment at the same time undergoes a relative increase, due to its no longer remaining smooth and even, but becoming covered by alternate elevations and drepressions. Until maturation approaches, the great growth in the peripheral gall-flower stratum of- the ostiolar face of the cavity causes it to rise above the level of the central area occupied by the male flowers and ostiolar bracts, and to form an elevated ring around it, and it is only at a late period that a central eminence is again formed by the ultimate evolution of the male flowers (Plate I, fig. 2).

At the period of access of the insects the receptacular cavity is empty, but shortly after entrance has been effected fluid begins to make its appearance, and gradually accumulates until the cavity is entirely occupied; the accumulation becoming so considerable as to give rise to sufficient tension to cause a jet of fluid to escape on perforation of the receptacular wall. The fluid is o{ dark reddish-brown colour, and has an alkaline reaction and a specific gravity ranging from 1111 to 11163. On filtration it is almost transparent, but in its natural condition it is cloudy, due to the presence of minute reddish-brown particles. These particles appear to be due to macerative disintegration of the bracts and perianths of the flowers, and specially of the male flowers, and, due to the normally dependent position of the ostiolar aspect of the cavity, they are often deposited in large quantities over it, and give rise to very deep coloration there. As the stamens, however, are very late in emerging from within the closed hood of their inner perianth, only beginning to do so at the period at which absorption of the fluid occurs, they are, as a rule, unstained and of a brilliant white colour. The fluid abounds in filarise, and also contains schizomycete elements and fungal cells, and sometimes various kinds of infusoria.

Just before final maturative changes set in—before the unfolding of the stamens and the escape of the insects from the ovaries are about to occur—the excessive flow of sap to the receptacles is arrested, and the fluid in the cavities is gradually absorbed and disappears. With this the consistence of the receptacles alters, and in place of being perfectly tense and hard, they yield somewhat on pressure. Their colour, too, changes from dark-green to reddish-yellow. The cavity is now once more empty, and its surfaces stained reddish-brown by the deposition of the particles and diffused colouring matter of the absorbed fluid. The colour varies in different parts from a very pale to almost black madder-brown, the depth of tint being determined by the greater or less dependence of the surface and its consequent liability to form a site of deposit. The deepest pigmentation, therefore, as a rule is around the male flower area, which now appears as a prominent eminence of crowded white filaments and anthers.

J).—Characters of mature gall-receptacles to which insects have not gained access.

The following data show the measurements obtained from four specimens :—

1	External diameter	2"·0
	Diameter of area of ostiolar braots and mala flowers	.0*-690
	Breadth of ame of male flowers	.0*-17
	Thiokness <>£reoeptaoular wall	.0*-28
	Depth of stratum of gall-flowers	.0-10

The internal surface of the receptacular wall was quite smooth. The interior of the cavity was of a pale umber tint over the area of the ostiolar bracts and the male flowers, and dark umber over the rest of the surface, due to the deep tint of the dry stigmata and styles.

2	External diameter	2"·05
	Diameter of area of ostiolar bracts in the cavity	.0»-58x(T47
	Breadth of zone of male flowers	.0*-21
	Breadth of peripheral furrow of gall-flowers around the male flowers on the ostiolarfaoe of the cavity	.0*21
	Thiokness of reoeptaoular wall	.0*-32
	Depth of stratum of gall-flowers	.0"10

The ostiolar bracts formed a projecting mass at the same level as the surrounding male flowers. The internal surface of the receptacular wall was smooth. The male flowers were arranged in three or four rows.

3.	External diameter	.2**33
	Diameter of area of ostiolar bracts in the oarity	.0*-62x0</-6
	Breadth of sone of male flowers	.<T19
	Breadth of peripheral area of gall-flowers on ostiolar face	.0" 3
	Thiokness of receptaoular wall	.0*3
	Depth of stratum of gall-flowers	.0*09

The ostiolar bracts formed a central boss on the same level as the male flowers, which were arranged in three rows. The male flowers and their investing bracts were of almost the same height. The perianth consisted of two outer overlapping leaves and of a continuous closed hood investing the stamens the filaments of which were very short.

4. Diameter of area occupied by ostiolar bracts in the cavity	0*42 to 0*48
Breadth of zone of male flowers	0*18
Breadth of peripheral furrow of gall-flowers around zone of male flowers	0*18

The area occupied by the ostiolar bracts was flat, and was surrounded by a somewhat elevated rim composed of the male flowers.

From the above data it is evident that in very many cases hardly any appreciable changes occur in gall-receptacles to which insects do not gain entrance after the normal period for access has been passed (Plate IV, fig. 23). A very slight general enlargement may take place, and a certain increase in depth of the stratum of gall-flowers, due to elongation in the pedicels of some of the flowers. There is, however, comparatively little increase in the size of the ovaries, and they therefore remain arranged in a single, or at utmost in a double stratum. Due to the very slight increase in bulk of the gall-flower stratum, there is no need for any increase in the surface to which it is adapted, and the interior of the receptacular wall remains smooth throughout. The cavity of the receptacle remains empty, no fluid accumulating within it. In many cases the male flowers remain practically arrested at the stage of evolution which they have attained at the normal period for access of insects. In some cases, however, a certain amount of fuHher evolution occurs, the flowers increasing in height, and their swollen apices coming to project beyond their investing bracts. In certain instances the growth is so considerable as to cause the zone of male flowers to form a prominent ridge around the central area occupied by the ostiolar bracts, and at the same time to be curved outwards over the peripheral furrow of gall-flowers so as almost entirely to conceal it from view.

II.—FEMALE RECEPTACLES.

A.—Character of female receptacles at the stage when they are ready for the access of insects (Plate III, fig.* 2).

The following are the measurements of a specimen of average size :—

External diameter	2*0
Diameter of area of ostiolar bracts in the oavity	0"52
Breadth of peripheral area on ostiolar aspect of the oavity occupied by flowers	0"'35
Thickness of solid ostiolar plug	0**43
Thickness of reoeptaoular wall	0*#24
Depth of floral stratum	0*·12

The area of ostiolar bracts formed a prominent mound on the centre of the ostiolar face of the cavity. It was of yellowish-white colour and the rest of the surface of a bright rose-madder tint, due to the continuous stratum of stigmata covering it. The ovaries were in two tiers, due to the fact that some of the flowers were sessile, while the others were shortly pedicellate. In spite of this the stigmas formed an almost even, uniform surface, partly due to absolute differences in the length of individual styles, partly due to those of the sessile flowers following a more straight-lined course (Plate III, fig. 5).

'B.—'Characters of/male receptacles after the accm of insects and prior to complete maturation.

The following measurements were taken from a receptacle a few days after the entrance of insects to its cavity:—

Diameter of area of ostiolar bracts in the cavity	.0* 77
Depth of ostiolar plug	.0*'52
Thickness of reoeptaoular wall	.0**34
Depth of stratum of flowers	.0**15

The ovaries were already visibly enlarged.

The first and constant change which manifests itself is an increase in the thickness of the stratum of flowers, due to increased bulk, specially of the ovaries, and a consequent decreased prominence of the mass of ostiolar bracts. In some cases the colour of the stigmatic surface remains for long almost or quite unaltered, but in others the tint changes from pure rose-madder to more or less brownish or brick-red. There is, however, never any tendency to withering or drying of the styles and stigmata, which, with the exception of the bases of the styles, remain persistent up to the period of full maturation and after the perianth has dried up and the outer coats of the ovary and of great part of the axis of the flower have undergone gelatinous degeneration. As in the case of gall-i^ceptacles after the access of insects, the increase in bulk of the ovaries is altogether out of proportion to that of the surface from which the flowers arise, and space for them is obtained by their becoming arranged in superimposed strata, due to unequal growth of the pedicels. As, however, the increase in bulk is not merely so great as is the case with the ovaries of the gall-flowers, the number of strata is not so great, only four or five being present in many cases, and six or seven in exceptional ones (Plate III, fig. 4). Another feature related to the minor amplification of the ovaries in female receptacles is that the receptacular wall remains smooth throughout in place of acquiring increased surface by means of inequalities as that of jrall-flower receptacles does. Just as in the case of gall-flower receptacles, the cavity becomes filled by fluid shortly after the access of the insects. The fluid differs from that of the other receptacles in being clear, colourless, or at utmost pale yellowish, and watery with only a few suspended particles, and in having an absolutely neutral reaction and a specific gravity only of 1000.

C—Characters of fully mature female receptacles to which insects have gained access (Plate III, figs. 4, 6, 7).

The following are measurements taken from such a receptacle :—

External diameter	.2**3
Diameter of area of ostiolar bracts in the cavity	.0*-42
Thickness of reeeptaoular wall	.0"*24
Depth of stratum of flowers	.0*-30

This specimen was one of average size, and considerably larger ones occur. Their dimensions, however, never approach those attained by the larger gall receptacles, the external diameter even in exceptionally large specimens being only about 2-75. The external surface is of a beautiful brick-red and yellow colour, being much more brightly tinted than that of the mature gall-receptacles ever is. As in the case of the latter, the receptacular fluid is absorbed as maturation approaches, and in fully ripe figs the cavity is empty. The interior surface is beautifully coloured, the bright yellow achenes shining through the transparent gelatinous material into which the outer coats of the ovaries have become resolved, and contrasting with the warm red colour of the stigmata and perianths. The substance of the receptacular wall is pale pink (Plate III, fig. 7).

2).— *Characters of mature female receptacles, to which insects have not gained access.*

If insects fail to gain access at the time when the receptacles are ready for them, very little change usually occurs during maturation save a gradual change of colour in the stigmatic surface to a strong brick-red and a gradual drying up of all the tissues. A slight increase in thickness of the stratum of flowers may take place, but due merely to elongation of the pedicels, and not as a rule to any ovarian enlargement. In certain cases, however, phenomena parallel to those occurring in those gall-flower receptacles, in which considerable growth of the male flowers occurs after the period for access of insects, but where access has not taken place, present themselves. In these a general enlargement of the flowers evidently takes place, and a varying, but sometimes considerable, number of the ovaries becomes conspicuously enlarged, forming in the first place a series of brilliant white eminences on the general red of the stigmatic surface where the affected flowers are pedicellate (Plate III, fig. 3), and ultimately in outward appearance coming to be identical with normal ripe ones, save that the outer coats of the ovary do not soften and gelatinize, and therefore do not allow the bright yellow of the sclerosed inner ones to shine quite so clearly through them. The growth of achenes in such cases only occurs in isolated flowers, and never over the entire surface as after insect access, and it is unaccompanied by any accumulation of fluid within the receptacular cavity—a circumstance which is probably causally related to the defective softening of the outer coats of the ovaries noted above. The general thickness of the floral stratum in such receptacles may amount to 0*17," and the ovaries may be arranged in four or five tiers. Achene formation may occur in sessile as well as in pedicellate flowers, and when it occurs in tall specimens of the latter, the mature achenes project somewhat above t the general surface.

The flowers of Mews Roxburghii.

In proceeding to a description of the several kinds of flowers present ia the receptacles of *Ficus Roxburgh^* it is again necessary to give details regarding the phenomena present at different periods and under the influence of different conditions,

I.—MALE FLOWERS.

A —Characters at the period for access of insects to the receptacle.

The stamens are at this time enclosed within three complete coverings. Externally is a large sheathing bract., which forms a hood over the summit of the entire flower and at utmost presents a mere fissure at one side (Plate IV, fig. 8). Within this ia a complete coat formed of the two, or in exceptional cases one or three, overlapping lobes of the outer perianth, and internal to this is the truly closed hood of the inner perianth, which forms a special protective covering for the stamens during the long period in which the flowers in galled receptacles are immersed in the receptacular fluid, and which is only ruptured when the latter is drying up.

The following figures show the dimensions of a flower at this stage:—

Total height	.1-3 mm.
Greatest breadth.	.1-02 mm.
Height after removal of the outer perianth.	.102 mm.
Breadth after removal of outer perianth.	.0-6 mm.
Total height of stameoB. . . . .;	0*4560 mm.
Length of filaments.	.01710 mm.
Breadth from face of anther-lobe to back of connective.	.0*1995 mm.

The flowers are practically sessile, the filaments of the stamens are rudimentary, and the anther-lobes very small and semi-transparent.

B.—Characters of male flowers in mature gall-recqptacles to which insects have gained access.

The following are the measurements of one :—

Total height from base of pedicel to apex of anthers.	.11-6 mm.
Height from base of pedicel to origin of outer perianth.	.3 3 mm.
Height *from* base of pedicel *to* bases of filaments.	.6*3 mm.
Length of filaments.	.4*5 mm.
Diameters of anthers.	.1xl'lznm.

All the flowers have a large sheathing bract inserted at the origin of the pedicel (Plate II, fig. 1). Most have two lobes in the outer perianth (Plate II, fig. 1; Plate IV, fig. $1, a$), some have only one, and monstrous flowers may have three. In such cases the axis at some little distance above the origin of the outer perianth divides into two branches, each of which bears a distinct inner perianth and stamens. The lobes of the outer perianth differ greatly in different instances in the extent to which they are separated from one another inferiorly. In some cases they are distinct throughout, but in most they are confluent inferiorly, and in some they are merely indicated by a shallow depression of the apex of one broad leaf. The ruptured inner perianth forms a funnel-shaped sheath around the-upper portion of the axis an^the bases of the filaments (Plate IV, fig. 1). The upper margin is ragged, the outline varying according to the precise fashion in which rupture has originally occurred and the extent to which the filaments have lacerated it in their final expansion. The stamens are two or three in nomber and are widely divergent (Plate IV, fig. 1, b), and the anther-lobes dehiscent by a fissure along the face. In a very large number of flowers a rudimentaiy ovary, style, and stignia terminate the axis between the bases of the filaments (Plate IV, figs. 1, 2, 3).

The pollen-grains are very small, having diameters, when fresh, of 14-5 x 8 ^, and when mounted in Canada balsam of 13·2 * 6-6^. They are normally oval with truncate extremities, where the cell wall is thinner than elsewhere, and which form the sites of exit for the pollen-tubes; when in mass they are, when fresh, pure white. In certain cases, in place of presenting the nonnal figure, they have the form of triangles the points of which have been cut off, and here there are three sites at which pollen-tubes may emerge. As a rule, they contain two nuclei—one rounded, the other oval or rod-like (Plate IV, fig. 7). The pollen does not tend to escape from the anthers after dehiscence if the stamens are undisturbed by insects.

The growth occurring between the period of access of insects and that of maturation is very great, but up to a comparatively late period is almost limited to the axes of the flowers. Elongation of the axis takes place both beneath the origin of the outer perianth, so that the flower ceases to be sessile, and above it, causing the closed inner perianth to force the leaves of the outer one apart and appear prominently beyond them, and forcing the summit of the terminal portion of the axis with the stamens more and more against the cupola of the inner perianth. The flower at the same time emerges from within the sheathing bract and projects beyond it. The filaments for long remain almost unaltered in length while maturative changes are occurring within the anthers. This is, no doubt, related to the retention of the stamens within the closed inner perianth, and the consequent protection of the anthers from maceration in the receptacular fluid. There is comparatively little increase in size of the anthers for some time, but the evolution of the pollen goes on, tetrad* being soon replaced by distinct small grains of normal form. These are at first uninucleate, and measure about 9-9X 6'6/A. in diameter. Distinct grains of such character are present within the anthers at a time when the lobes of the outer perianth have only begun to separate and the filaments show no appreciable elongation. As maturation approaches, and just before the absorption of the receptacular fluid, the anthers become visibly swollen and the filaments begin to grow rapidly. As the stamens are still enclosed within the closed cavity of the inner perianth, the elongating filaments are not free to grow directly onwards or outwards, but become extremely folded upon themselves, the basal portion running downwards along the sides of the axis, and the distal halves being folded upwards more or less parallel to them (Plate IV, fig. 1, a).

The inner perianth becomes more and more stretched by the increasing bulk of the stamens and the upward growth of the terminal portion of the axis from which they arise, and the tension ultimately becomes so great that rupture occurs. As a rule, this occurs at the summit, so that the inner perianth comes to form a cup or funnel around the upper part of the flower; but in some instances it takes place at the base, and the perianth is then carried upwards as a cap on the apex of the axis and the stamens until the latter expand and lacerate it. Rupture of the inner perianth does not usually occur until the absorption of the receptacular fluid has taken place, but in exceptional cases it may partially occur before the fluid has entirely disappeared. Once rupture has taken place, the complete evolution of the flower occurs with great rapidity. The stamens become widely divergent and protrude far beyond the ruptured perianth (Plate II, fig. 1, b). The extreme protrusion is due partly to the tip of the axis rising on the removal of the restraint% pressure of the perianth, and partly to continued growth in the stamens, but to a much greater extent to mere unfolding of the filaments. The divergence of the stamens varies in degree in different instances, and is specially marked in flowers in which abortive female organs are present. Dehiscence next sets in in the faces of the lobes of the oval anthers, but, as previously mentioned, spontaneous discharge of pollen does not seem to occur.

C—Characters of male flowers in mature gall-receptacles to which insects have not gained access.

In many cases little or no farther growth seems to take place after the time at which the receptacle was ready for the access of insects, and the flowers merely undergo a gradual process of desiccation. In some, however, as has been already mentioned in describing the receptacles, a certain amount of evolution occurs, the flowers increasing considerably in length and, with their bracts, coming to form an elevated and reflected band around the area of sterile ostiolar bracts. The flowers only rarely project beyond their proper bracts, and the outer perianth remains closed, due to the persistent overlapping of its lobes. The following were the measurements of such a flower :—

Total height	4·6 mm.
Height of stamens	2-5 mm.
Breadth from face of anther-lobes to most prominent part of connective	1-0 mm.

The flowers, thus, in such cases of partial maturation, independent of the access of insects, acquire dimensions four or five times as great as they have at the proper period for the occurrence of access. The anthers become much more conspicuous, and acquire a yellowish-white tint, but the filaments remain almost unaltered in length (Plate IV, fig. 4). Transverse sections through the anther-lobes show that the evolution of pollen has advanced to the stage of the formation of tetrads (Plate IV, figs. 5, 6). These form dense masses surrounded by a double stratum of large tapetal cells, which in its turn is for the greater part embedded in tissue the cells of which have undergone fibrous resolution. This fibrillation has advanced to the greatest extent between the loculi and along the central portions of the faces of the lobes. In the latter site even the epidermal cells have disappeared, and the loculi are only covered by the persistent cuticle and the subjacent fibrous stratum (Plate IV, fig. 5). The evolution of the anthers, however, never advances beyond this stage if insects do not gain access to the receptacle, and distinct pollen-grains are never formed.

II.—GALL-FLOWERS.

A.—Characters of gall-flowers at the period for access of insects to the receptacles.

The following are the measurements of various specimens, some of the flowers being sessile and others shortly pedicellate:—

1. Averages of six flowers—

Height from base of pedicel to summit of ovary	0·456 mm.
Greatest breadth of ovary	0-436 mm.
Length of style along its inner side	0-478 mm.
Diameter of stigma	0-285 mm.

2. Height from base of pedicel to stigma, which at this time is the highest point . . . . 0·826 mm.

Height from base of pedicel to ovary	0·427 mm.
Greatest breadth of ovary	0-399 mm.
Length of style along its inner side	0-256 mm.

3. Average length of styles in ten flowers—

Along inner side . . . . 0·876 mm.

ranging from 0·285 mm to 0·427 mm.

4. Average length of styles in five flowers—

Along inner edge . . . . 0·384 mm.

5. **Total height of flower from base of pedicel to stigma . . . . . 1-28 mm:**

Height from base of pedioeltotopof ovary	0.912 mm
Greatest breadth of flower, including the perianth	0*484 mm
Length of stjle along inner side	0"427 mm.

6. **Average measurements of large pedicellate flowers—**

Total height from base of pedicel to stigma	1-5 mm.
Height from base of pedicel to origin of perianth	0-4 to 0.5 mm.
Height from origin of perianth to ovary	0*25 mm.
Height from base of ovary to its summit	0*48 mm.
Length of style along inner side	Q·48 mm*
Breadth of stigma . . . . ! ! !	0-2 mm!

Considerable variations exist in the total heights of the flowers, these being mainly determined by theabsence or presence of a pedicel (Plate II, figs. 2, 4), but also to some degree by variations in the lengths of the styles. The gamophyllous perianth has three lobes, a broad one being situate opposite to the side of stylar attachment, and two narrow ones passing upwards, one on each side of the base of the style (Plate II, fig. 4). The tips of all three lobes rise above the level of the summit of the ovary, and that of the large one curves over it The style is attached practically to one side of toe summit of the ovary, which is flattened or only slightly convex (Plate II, fig. 4 ; Plate IV, flg. 19). The stigma is trumpet-shaped, or in some cases furrowed. The bottom of the hollow communicates by a small orifice with a canal which descends through about three-fourths of the length of the style, growing as it does so and coming to a pointed end at some distance from the ovary (Plate IV, fig. 19). The lower fourth of the style is solid throughout. It, external surface is quite smooth throughout. The stigma and the upper portion of the styles have a more or less pronounced pink tint, due to the presence of varying numbers of coloured cells; the ovary and perianth are colourless.

The omy externally is broadly oval, and a. ^ k ^^ ^^ H (ate ^ % . I? 9) I* watt, ™, g^aj m tkoknea, in different parta, being mneh thiok«t .long the ride of styUr in^fon, thumn* ofi thence in every direction, and becoming Tery thin on the ride

s at different

Thickness at origin of the inner side of the style . .	0·A5 mm.
Thickness over the middle of the summit of the ovary	0·04 ZDin*
Thickness over surface of ovary on the side opposite that of stylar attachment	0015

Along the inner side of the base of the style and the neighbouring areas of the ovarian wall the epidermal ceUs are shortly columnar and have somewhat thickened walls (Plate IV, fig. 19). Further out they become thin-walled and squarish, and over the rest of the surface except die basal portions, where they again tend to become cylindrical, they are more or less flattened. There are four distinct layers in the thickness of the walls (Plate V, fig. 22). Immediately beneath the outer epidermis is a single stratum of flattened cells, which at this stage stain like the epidermal ones; beneath it is a thick layer of four, cr five superimposed steata of small cells, which take a pink tint with picrocarmine, and within this is the inner epidermis, the flattened cells of which, like those of the outer epidermis and hypodermis, are stained yellowish.

The ovule presents a more or less rounded outline, due to the great thickness of the funicle and of the secundine of the funicular side at this stage of development (Plate IV, fig. 19). The free portion of the funicle is very short, being only about 0*01 mm. in length by 0·09 mm. in breadthi..

It arises immediately beneath the base of the style, and the fibrovascular bundle curves abruptly downwards, and is continued in a raphe to the base of the more or less erect nucellus (Plate IV, fig. 19). The thickness of the secundine along the raphe and the stylar aspect of the upper part of the nucellus is very great; so great, in fact, as not to suggest an integument, but a solid mass of tissue into one side of which the nucellus is inserted. In a case in which the thickness was measured, at the point of greatest depth it was 0*04 mm. The entire ovule in this specimen was 0*20 mm. in length by 0-15 mm. in breadth, and the nucellus had a height of 0-15 mm., a greatest breadth of 0-09 mm., and a breadth in the micropyle of 0-06 mm. The secundine, especially on the funicular aspect, appears to be but loosely connected superiorly with the nucellus, and tends to separate more or less from it towards the micropyle (Plate IV, fig. 19). The nucellus is erect or slightly inclined outwards, and is practically straight, its apex facing the under surface of the wall of the top of the ovary (Plate IV, fig. 19). The micropyle, as the measurements given above show, is relatively very large. The epidermal stratum of the nucellus presents a general resemblance to that of the ovules in the normal female flowers, being thin and composed of flattened cells over the greater part of the surface, and forming a conspicuously thickened mass which plugs the orifice of the micropyle. This plug is not, however, so thick as in the female flowers, and is apparently also of looser texture than in them. Within the epidermal coat a stratum of loose tissue is present around the embryo-sac. It also generally resembles that present in the ovules of the normal female flowers, but at the same time it does not form a definite dense cap over the apex of the embryo-sac as it does in them, there being merely a certain thickening of the common loose tissue there.

B.—Characters of gall-flowers subsequent to access of insects to the receptacle.

The following figures show the measurements of a gall-flower shortly after access of insects to the receptacle, and containing an insect's ovum which as yet showed no signs of segmentation :—

Total height from base of pedicel to summit of the stigma . . .	2-850 mm.
Height from base of pedioel to summit of ovary.	.27075 mm.
Length of. style along the inner side.	.0-4275 mm.
Length of pedioel helow the origin of the pearinth.	1-282
Transverse diameter of ovary.	.05700

n 1 a t this stage havo an obovate form, and when removed from the ovaries and 11 Id Ilue to extraction of the fluid from the interior of the embryo-sac in the course of coliaps ..r m eagur6 a|,out 0*8 x 0*6 mm., and in their normal condition about 0-8 x 0-57.

F e P art FrViTthe above figures it is evident that the deposition of ova causes a very rapid and considerable increase in the size of the flowers generally, tfce increase being invariable • rti ovaries and ovules, but in many cases occurring in the axis also, and determining very in —e «Wous elongation of the pedicels. The enlargement in the ovules appears for the conspiuu n st part to be dı e^ ^ ^^ extension of pre-existent cell elements under the influence of detention of the embryo-sac, due to a large accumulation of fluid within its cavitv; but a certain amount of active protoplasmic accumulation, and eyen of cell multiplication, appears to take place in the deeper nucellar tissue. The cells of the latter appear to be rich in protoplasm, and stain deeply with carmine, and at some points specially deeply-stained patches are present which appear to correspond with localised centres of specially active growth (Plate IV fig. 14). Towards the apex of the nucellus there is generally a special accumulation of cells belonging to the deeper stratum, but these do not differ from their neighbours elsewhere, and never form a dense coherent mass like the apical cap of the deeper nucellar tissue in normal female flowers (Plate IV, fig. 15). The nucellar epidermis presents features very similar to those characterising it previous to the access of insects. It forms a thin stratum over the greater part of the surface, becoming somewhat thicker at the base of the nucellus, and forming a plug at the micropyle. The latter is now relatively much smaller than it was, and is no longer vertical and at the summit of the ovule, but is directed to the funicular side, and often situated almost vertically over the funicle (Plate IV, fig. 14). The increase in vertical diameter of the ovule evidently takes place much more in a descending than an ascending direction, for the distance between the upper edge of the funicle and the micropyle and apex of the ovule remains comparatively short, while the raphe has undergone great elongation. The funicle and the secundine have now greatly reduced relative proportions, the former appearing as a short narrow cord, and the latter as a mere thin investing stratum. The increased bulk of the ovule is evidently principally determined by a great accumulation of fluid within the embryo-sac distending it and stretching the surrounding tissues.

The insect-ovum is not merely situated within the ovary: it is deposited within the ovule, or, more exactly, within the nucellus, lying between the epidermal stratum and the loose tissue surrounding the embryo-sac, at a point just below the insertion of the funicle (Plate IV, figs. 14, 16). It is pedicellate and of a long oval form, the pedicel being attached to the loose cellular tissue of the deeper nucellar coat (Plate IV, fig. 17). It has apparently two walls—an external one, with which the pedicel is connected, and an internal one around the large granular mass of protoplasmic contents. It is evident that considerable growth must occur subsequent to deposition and antecedent to the commencement of cleavage, as the bodies of ova at this period give diameters of 0-108 x 0·0342 mm., and contain a dense maas of protoplasm measuring 0-0855 x 0*0342 mm., whereas the spherical ova expressed from the bodies of female insects at the time of access have a diameter of only about 0-057 mm., and contain a netted protoplasm (Plate IV, figs. 17,18). The pedicel is about 0-05 in length, and the lower extremity is slightly dilated (Plate IV, fig. 17).

Subsequently, during the period when the development of the insect is occurring, very little actual growth of ovular tissues occurs, the inner coat of the nucellus and the embryo-sac appear to atrophy and disappear completely, and the nucellar epidermis and secundine become gradually converted into a delicate sheath investing the body of the embryo. The inner cells of this sheath, presumably representing the nucellar epidermis, become greatly extended in surface and altered in form, and the stretching of the tissue tends to separate them from one another, so that large intercellular intervals come to be present among them. At the same time they become very poor in protoplasm, but retain their nuclei for a very considerable time (Plate IV, fig. 20).

The walls, of the ovary increase in thickness, but to a much less degree than in the true female flowers, the depth in mature ones not being more than double what it is at the period of access. Figure 25 of Plate IV shows the appearance of the ovarian wall in a gall-flower approaching maturity. It shows that very considerable increase in the size of the cells, and specially extension in their areas, has occurred. The external epidermis is thickly cuticularized and the walls of the internal epidermis and the stratum external to it are considerably thickened. There is no softening of the external strata of cells similar to that occurring in the ovaries of true female flowers during maturation.

The total increase in bulk of the gall-flowers during maturation is enormous, and far exceeds that occurring in the case of the true female ones. The ovaries ultimately become about three times as large as they were at the period of insect access, and in many cases there is excessive growth in the pedicels. The actual length of pedicels in mature flowers varies greatly. In some cases the flowers remain almost or quite sessile, in others the pedicels may be as much as eight times longer than they are in any pedicellate flowers at the period of access. There is little or no increase in size in either the perianth or the style and stigma subsequent to insect access. In mature flowers the perianth forms a mere cup around the base of the enlarged and projecting ovary, and the styles, in place of being at one side of the apex, arise so far down the lateral surfaces that the stigmas are situated at a lower level than the now rounded summits of the ovaries (Plate II, fig. 3).

C—Characters of gall-flowers in mature receptacles to which insects have not attained access.

A certain amount of growth occurs, so that the flowers externally come to resemble those in receptacles shortly after the access of insects. The following are the measurements of a tall pedicellate flower :—

Total height from base of pedicel to stigma	2·707 mm.
Height to lower part of ovary	2·56 mm.
Height to base of ovule	1.68 mm.
Height from level of origin of perianth to top of ovary	2-08 mm.
Length of style	0*627 mm.
Diameter of stigma	0-313 mm.
Diameters of ovule	0-4275 x 0·285 mm.

The ovule is reduced to the condition of a dry thin-walled sac surrounding the large empty cavity of the embryo-sac. The increased size of the flowers is mainly due to growth in the pedicels, as the perianth still curves over the top of the ovary.

III.—TRUE FEMALE FLOWERS.

A.—Characters of female flowers at the period of ***access of insects to the receptacle.***
(Plate IJ, figs. 5, 6).

As in the case of the gall-flowers, while the size of the ovaries is fairly constant at this stage, that of the flowers as a whole varies considerably, due to the fact that while some are sessile, others have pedicels of varying length (Plate III, fig. 5).

The following figures show the measurements of two flowers with well-developed pedicels :—

1. Height from base of pedicel to the lower edge of the insertion of the style	1-51 mm.
Height from the lower edge of the stylar insertion to the summit of the ovary	0-62 mm.
Total height from base of pedicel to summit of ovary	2*13 mm.
Height from summit of ovary to summit of curved style and stigma	1*28 mm.
Height from base of pedioel to insertion of perianth	0*48 mm.
2. Total height from base of pedicel to summit of ovary	125 mm.
Height from base of pedioel to insertion of perianth	0*37 mm.
Height from upper edge of stylar insertion to summit of ovary	0*25 mm.
Height of ovary	0*5130 mm.
Breadth of ovaxy at level of upper edge of stylar insertion	0*48 mm.
Length of style and stigma	1*56 mm.
Breadth of stigma	0*17 mm.

The gamophyllous perianth, as in the case of the gall-flowers, has three lobes: a broad one opposite the side of stylar insertion, and two narrow ones—much narrower than the corresponding ones in the gall-flowers—passing up one on either side of the base of the style. The lips of the lobes curve around the edges of the convex summit of the ovary. The style is inserted much lower down than in the case of the gall-flowers, the summit of the ovary always rising conspicuously above the site of insertion (Plate II, fig. 6). The style is relatively long, and over its upper half is clothed with long pointed hairs. The stigma is normally clavate and covered by the projecting extremities of the epidermal cells. In the case of one of the trees in Calcutta, however, the stigmata, in place of being clavate, are abruptly truncate, with more or less cup-shaped extremities, as though representing a condition intermediate between that proper to true female and gall-flowers. In the fresh state the stigma is of a bright rose-madder tint, and the style and perianth are pale pink. The ovary is broadly oval externally, and contains a large oval cavity. The walls are thick, especially at the apex (Plate V, fig. 1). Like those of the gall-flowers, they are composed of four distinct strata, an external and internal epidermis, and two intermediate layers. The characters of the component cells, and specially those of the epidermal strata, are very different from those in the corresponding tissues in the gall flowers (Plate V, figs. 1, 17). The external epidermis is formed of broad cylindrical cells with a distinct cuticular covering. The hypodermis consists of thin-walled cells, which, over the greater part of the surface, are arranged in two or three rows, but towards the apical thickening of the walls in four or five (Plate V, fig. 1)- Beneath this lies a single stratum of very small fells, the nuclei of which are relatively large and stain very deeply with logwood. Many of these cells contain more than one nucleus. The cells of the internal epidermis are again cylindrical, and frequently present a more or less sinuous outline. Covering their internal extremities, and lining the ovarian cavity, is a thin but well-differentiated cuticle, which tends readily to separate in the course of preparation of specimens. The following figures show the thickness of the entire wall and of the individual strata over the greater part of the ovary:—

Total thickness of the wall		Q-099 mm.
Thickness of external	epidermis	0§0231 mm.
Ditto	hypodermis	0-0330 mm!
Ditto	stratum of small cells	0-0099.
Ditto	internal epidermis	0-0330.

Over the summit of the ovary the total thickness is considerably greater, mainly due to the increased accumulation of hypodermal tissue there.

The ovules are both much larger, and also evidently at a more advanced stage of evolution than they are in the gall-flowers of gall-receptacles at the period of access of insects.

The measurements of specimens of average dimensions when freshly removed from the ovaries and not compressed are 0-3420 x 0-1995 mm. In place of presenting a more or less rounded outline like the ovules of galLflowers at a corresponding period, they have a long oval figure (Plate II, fig. 6; Plate V, fig. 8). The funicle is attached to the ovule much lower down than it is in gall-flowers, this being related to the fact of the lateral in place of apical insertion of the style, as the origin of the funicle is here, as in the gall-flowers, invariably situated just below the base of the latter. In consequence of this the raphe is of course relatively short. The ovule as a whole stands almost erect in the ovarian cavity, with only a slight inclination to the stylar side; but the nucellus is curved so far as to bring the micropyle almost vertically over the funicular insertion f Plate II, fig. 6). The free portion of the funicle is very short, and the fibro-vascular bundle is curved sharply downwards and continued in a raphe to the base of the ovule, where the vessels become continuous with a mass of spiral cells, which form a cup-like expansion over the latter. The fibro-vascular bundle of the funicle arises at some distance below the base of the ovary, due to dichotomy of that of the axis, and curves outwards, upwards and inwards, so as to reach the cavity of the ovary just beneath the level of the origin of the stylo f Plate II, fig- 6). The other bundle resulting from the dichotomy ascends on the opposite aide of the ovary, and tapers off and disappears at a level corresponding to that at which its neighbour enters the ovarian cavity (Plate II, fig. 6). The origin of the funicular fibro-vascular bundle is certainly not of this character in the true female flowers of all species of ficus. For example, in those of *F. Mspda* there is no dichotomy of the axial bundle, but the latter, as a whole, is diverted to one side and continued as the funicular one.

The'secundine consists of elongated cells with their long axes parallel to that of the ovary (Plate V, fig. 1). The cell-walls are thin, the cytoplasm scanty, and the nucleus small and stalling feebly, with logwood or carmine. Its thickness varies greatly over different parts of the surface of the nucellus. It is thinnest over the side opposite that to which the funicle is attached, and in great part here contains only two strata of cells. It is also relatively thin over the base of the nucellus. On the side of attachment of the funicle it attains its greatest thickness, a prominent ridge passing upwards from the site where the funicle passes into the raphe to the micropyle, and gradually subsiding on either side and towards the latter. It leaves a large micropyle through which a thick maas of cells belonging to the nucellar ep^ermis projects (Plate V, fig. 1).

The characters of the nucellus are somewhat peculiar and require detailed description. The epidermal stratum varies greatly in thickness and in the character of its constituent cells in different places. Except at the base and true apex of the nucellus, it is thin, containing not more than from one to three strata of very minute, elongated cells with their long axes parallel to that of the ovule (Plate V, figs. 1, 21). They contain relatively larjre nuclei, which stain deeply with logwood or picrocarmine, ihe cell-walls acquiring a brownish tint with the latter reagent (Plate V, fig. 8). At the base it thickens out into a solid mass of cells, which rests as in a cup in the expansion composed of spiral cells in which the spiral vessels of the raphe terminate, and is in contact above with the thick basal portion of the delicate cellular tissue surrounding the embryo-sac (Plate V, figs. 7,21). At the apex also a great accumulation of cells is present, forming a solid plug containing five or six strata which fills the micropylar orifice and projects somewhat beyond it (Plate V, fig. 1). The cells in both the basal and micropylar thickenings differ in form from those in the rest of the epidermal stratum, as they are square or polygonal in place of flattened.

Within the epidermal stratum is a coating of delicate, loose cellular tissue surrounding the large embryo-sac. This also presents basal and apical thickenings where the tissue becomes much denser and more coherent than it is eleswhere (Plate V, fio-s. 1, 7). The basal thiokening consists of many superimposed strata of cells, which °are frequently associated so as to form more or less distinctly defined lobes (Plate V, fig. 7). The apical thickening is very peculiar (Plate V, fig. 1). It forms a dense, broadly conical 'mass capping the apex of the embryo-sac. The constituent cells are closely adapted to one another are quadrangular or polygonal in outline, and contain relatively large, deeply-staining nuclei. Centrally the cap is of great thickness, containing six or seven strata of cells (Plate V fig 1)* It thins off all round peripherally, and gradually subsides into the surrounding loose cellular tissue covering the lateral surfaces of the embryo-sac. Under the influence of the reagents employed in mounting permanent specimens of ovules, and specially of entire ovules the inner nucellar coat frequently shrinks away from the epidermal one save at the base so as to leave a clear space between them (Plate V, fig. 8). The walls of the cells do not show the brownish tinge with picrocarmine which those of the epidermal stratum do, and the large nuclei, save in the apical thickening, stain comparatively feebly.

Within the general mass of nucellar parenchyma, as this stratum maybe conveniently termed, and immediately around the embryo-sac, a certain number of small flattened cells appearing fusiform in profile, are present (Plate V, fig. 1). These are most abundant as a rule, towards the apex of the nucellus. Immediately beneath the apical cap, and attached to oneof its constituent cells, is a large and peculiar cell of this type (Plate V, figs 12 3 4 5 6) In sectional view it appears as a curved spindle with the centre of'the convex s'urface attached to the under surface of the apical cap, and the prominence of the concave one in contact with, or in close relation to, the outer surface of the apex of the embryo sac This prominence is sometimes very marked, and where the embryo-sac has not shrunk too far away in the course of preparation of the specimen, it often appears to depress its apex while the two pointed extremities of the spindle project free on either side as lateral hornsVpiat* V, fig. 6). The entire body of the spindle is characterised by staining? ^ T S ? especially with logwood. o 'J -w rv>

The centre of the nucellus is occupied by a huge embryo-sac, with a delicate membranous wall, a network of finely molecular protoplasm, and a large nucleolate nucleus (Plate V fig. 3). There do not, as a rule, appear to be any oosphere, synergida or`«»«» 1I cells. Only in one case have I been able to detect fny thing "which m ^ n ^ y £ « £ to represent an oosphere and synergid^, and in fcat the appearances were doubtful, and^uch as could only correspond with elements of very abortive character.

B.-Characters of female fibers shortly after access of insects to the receptacles.

The following show the measurements of a pedicellate flower a few days after the access of insects to the receptacle:— access

Total height from base of pedicel to summit of ovary. . .	3-02 mm.
Height from base to origin of the perianth . . ' ' '	I.*A
Total height of ovary.	.«*«**'

Breadth of ovary at level of upper edge of stylar insertion . . .	0-65 mm.
Height from upper edge of stylar insertion to summit of ovary .	0-51 mm.
Total length of style and stigma.	.156 mm.
Breadth of stigma.	0·17 mm.

These figures very clearly indicate the occurrence of rapid growth in the ovaries and, in the case of pedicellate flowers, in the pedicels subsequent to the access of insects. The perianth retains its previous dimensions, and the ovary consequently comes to project more and more from it. Even at the early stage represented by the flowers of which measurements have been given, the summit of the ovary rises high above the tips of the perianth. The origin of the style, just as in the case of the gall-flowers, appears to descend, due to excessive growth in the upper part of the ovary, and in some cases the colour of the upper parts of the styles and the stigmata gradually changes from rose-madder to brick-red. Beyond this neither styles nor stigmata show any change, and, with the exception of the basal portion of the style, which ultimately becomes softened, remain persistent up to the period of maturation of the seeds and long after the outer coats of the ovary have undergone mucoid degeneration. The walls of the ovary gradually thicken, the increase being mainly due to changes taking place in the two inner strata; the cells of tbe internal epidermis increasing in depth and in the thickness of their walls, and processes of cell multiplication occurring in the stratum of small cells lying external to them. The general increase in the bulk of the flowers even within a few days subsequent to access of insects to the receptacles is so considerable as to be very evident even to casual inspection by the unaided eye. The important phenomena are those manifesting themselves in the ovules. These, when removed from the ovaries a few days after access of insects to the receptacles and examined in water and uncovered so as to avoid flattening, give diameters of about 0-51 xO-34 mm. The secundine and nucellar epidermis show no important changes save thoae dependent on extension, due to increased bulk of the deeper parts of the nucellus, but conspicuous changes soon set in in the nucellar parenchyma and embryo-sac. In the former there is, firstly, general growth around the sides of the embryo-sac, and secondly, special growth at its base and apex. The cells of the loose tissue of the parenchyma begin to increase in size, they stain much more deeply than they did previously, and there is an obvious accumulation of protoplasm within them (Plate V, fig. 9). Beneath the base of the embryo-sac the accumulation of cells becomes thicker and denser than it was before, and in some cases, at all events, a peculiar local outgrowth takes place on its upper surface, giving rise to a prominent circular mound of very small-celled tissue surrounding a central depression, and apparently strongly cuticularised on the surface (Plate V, fig. 16). As it is developed, it pushes up and invaginates the lower end of the embryo-sac.

The walls of the cells of the apical cap generally become considerably thickened, but do not otherwise show any appreciable change. The special cell attached to its under surface, and which appears as a deeply-stained spindle in section, on the other hand, undergoes very remarkable development. It swells up centrally, and at the same time the peripheral portions shoot out into large processes and become gradually separated by partitions from the central dilatation (Plate V, figs. 11, 12). In sections it would appear as though we were dealing with changes occurring in a simple spindle, but, judging from the appearances present in some cases in entire or partially-dissected ovules, it appears to be probable that in reality the cell originally consists of a central more or less convex mass with radiant and pointed processes passing off from it in various directions (Plate V, fig. 11), &d that in the course of evolution it becomes separated into a central, prominent dilation, and a series of horn-like cells radiating from it. Be this as it may, at this stage there is a prominent central cell pressing down upon the outer surface of the embryo-sac, and two or more elongated peripheral ones arising from it laterally and clasping the adjacent surfaces of the sac (Plate V, figs. 14, 15). At this period the apex of the embryo-sac is still readily separable from the cells, the site of contact with the central one, however, being sometimes recognisable after separation has taken place, due to its staining differently from the rest of the sac-wall (Plate V, fig. 13). The central cell continues to increase more and more in prominence, pressing down, invaginating, and apparently ultimately penetrating through the apex of the embryo-sac, and, at the same time, the peripheral cells shoot out into long horn-like processes with dilated bases adherent to the sides of the central one, and frequently showing secondary dilations farther out, which, like the basal ones, are nucleate (Plate V, figs. 12,14, 15). From their position and relations to neighbouring structures, these lateral processes appear to be specially adapted to fix the central cell as it prases down on the apex of the embryo-sac. Subsequently, as the result of a process of free-cell formation, or rather, perhaps, of rejuvescence followed by cell-dmsion on the part of the contents of the central cell, a series of three cells arises within it arranged in linear series (Plate V, fig. 12). The two first of these appear to play the part of a suspensor, the basal one appearing to be adherent above to the membrane of the mother, cell, and therefore through it to the under surface of the apical cap of the nn_{Ce}ll«r parenchyma. The distal or inferior cell swells up, becoming, firstfrnore^ h t ^ heri 1· and then broadly clavate, and the dense protoplasmic contents give origin by free Z division to an aggregate of nucleate protoplasts constituting the pro-embryo (Plate V, figs. 12, 14, 15). At this stage the central cell and its contents measure about 0-033 x 0-016 It J S S S ' " -T H * " * * the " " - I -Us goes on, they come to p r * s upon the interior of the walls of the parent one, and its outlines become undistinguishable.

The embryo-sac remains apparently structurally unaltered for a short time after the access of insects to the receptacle, merely increasing in capacity, due to accumulation of fluid within it. At a period when the embryogenic cell already has begun to enlarge, and its

the latter

(Plate V,

fig. 13). A Utfle later, however, this duappe™, and is replaced by a large number of much smaller secondary one,, which are scattered over the inner Jf.ce of ti,e wall of the .ac, and at the same tune an increase in the substance of the network of e ytoplasm seem, to occur (Hate V, fig,. 9, 10). So long a. the embryogenic cell merely d the apex of the sac. the latter is readily sepa&bk under the influence of r J g e n T C .he apical cap of the nuceUar parenchyma, but after .dhesion or actaal p e r K o n S the ape* ha, occurred, tlm is no longer the ca», and the sac adheres so firmly to the eap that on several occmons I have been able to detach them from the rest of the ovule «. ««.« by tearing off the micropylar extremity, the lower portion of the sac being drawn out of .he .nfenor half of Ae ovule in the process of removing the two porhonsfrom one another, Time hM not yet sufficed for an examination of The detail, of the evol«t,on of the embryo after this stage has been reached, and I have therefore

by the mature

C.—Characters of female flowers in mature receptacles which have been entered by insects.

The following figures show the measurements of two mature flowers from the same receptacle:—

1. Flower provided with a well-developed pedicel—

Total height from base of pedicel to apex of ovary.	.5*61 mm.
Height from base of pedicel to origin of perianth.	.2·85 mm.
Total height of ovary.	.1*05 mm.
Height from the upper edge of stylar insertion to apex of ovary . . .	0· 6 mm.
Breadth of ovary at level of upper edge of stylar insertion	0*88 mm.
Length of style and stigma.	.1·56 mm.
Breadth of stigma.	.0·14 mm.
Height of base of ovary above tips of perianth.	.0-2 mm.

2. Flower absolutely sessile—

Total height from base, *i.e.*, origin of perianth to summit of ovary . .	2*02 mm.
Height from base to level of bifurcation of the fibro-vascular bundle. •	079 mm.
Height from bifurcation of fibro-vascular bundle to base of ovary proper	0*2 mm.
Total height of ovary.	.1·03 mm.
Height from the level of upper edge of stylar insertion to summit of ovary.	.0·54 mm.
Breadth of ovary at level of upper edge of stylar insertion	1*08 mm.

The following are the dimensions of an exceptionally tall flower:—

Total height from base of pedicel to summit of cuticular sheath of ovary.	.6·46 mm.
Height from base of pedicel to origin of perianth.	.3*50 mm.
Height from origin of perianth to level of bifurcation of fibro-vascular bundle.	.1*14 mm.
Height from bifurcation of fibro-vascular bundle to base of acheno •	0*54 mm.
Height of achene •.	.0·99 mm.
Height from summit of aohene to cuticular sheath of summit of ovary.	0*28 mm.
Height from level of upper edge of stylar insertion to summit of ovary.	.0'76 mm.
Breadth of ovary, including gelatinous sheath, at the level of upper edge of stylar insertion.	.1*22 mm.
Breadth, excluding gelatinous sheath.	.1 09 mm.

The total height o# the flowers now varies very greatly on account of the varying amount of elongation of the axis, both below the origin of the perianth and between this point and the base of the ovarv nroner. which has taken place in different instance /Plot* III, fig. 4). The peduncle is softened and semi-transparent, so that the fibro-vascular bundle can be seen shining through its substance. The lobes of the perianth retain their original size and are well preserved, not showing any signs of softening, but being dried up and of a reddish tint (Plate III, fig. 7). The portion of the axis between the origin of the perianth and the base of the ovary is much softened, and the tissue to a great extent converted into a transparent, gelatinous substance in which the bifurcation of the vascular bundle beneath the ovary can be readily seen. The cuticular stratum of the entire ovary is widely separated from the subjacent tissues in the form of a delicate membranous sac containing a stratum of clear gelatinous material. The cells of the external epidermis beneath it are now no longer columnar, but broadly flask-shaped, and open externally by wide circular orifices (Plate V, fig. *19),* marking's corresponding' to which are traceable on *the* inner surface of the detached cuticle.

The cells still adhere laterally to one another with considerable tenacity, and large sheets of them can therefore be readily detached. This is not so with the cells of the hypodermia, which are degenerate, softened, and so much loosened from one another as to form an incoherent gelatinous stratum (Plate V, fig. 20),'saVe where the? under portions of the deepest ones adhere to the outer surface of the achene to form a pseudo-cuticular coating to it (Plate V, fig\ 18). The achenes measure about 1'02 x 0-7 mm,, and are of a bright yellow colour. Their walls have a total thickness of 0-089 mm. Beneath the pseudo-cuticular coat is a stratum built up of masses of what appesyr to be very small, completely sclerosed cells, arranged in columnar groups, and which represent the ultimate product of the stratum of small cells immediately external to the internal epidermis of the immature ovary (Plate V, fig. 18). This layer is about 0'03 mm. in thickness. Internal to it is one about 0'056 mm. in thickness, and consisting of the modified internal epidermis. The cell cavities are greatly reduced in size, and are represented by a mere system of curiously ramified, slender channels (Plate V, fig. 18). So complete and uniform has the sclerosis around these been, that the sites corresponding with the original cell-walls are only indicated here and there by the apposition of the somewhat dilated extremities of the fine lateral twigs of the large oblique or vertical channels.

The stigma and the distal portion of the style remain persistent and unaltered, but the basal portion of the latter ultimately undergoes changes parallel to those taking place in the superficial strata of the ovary. As a result of these, the cuticle becomes detached as a sort of tubular diverticulum of the ovarian cuticular sac, and the deeper tissues gelatinise, so that it becomes difficult without special care to procure specimens of the flowers with the styles still adherent.

The mature seeds are somewhat difficult to remove intact from the interior of the achenes, due to the small size and resident coats of the latter. Soaking in sulphuric acid, however, facilitates the process, as, under the influence of this, the achenes tend to separate more or less completely into two lateral halves and allow the seeds to escape. They are provided with a thin outer coat, consisting of empty flattened cells in several strata, corresponding to those of the secundine and nucellar epidermis of an earlier period of development. Within this are two strata of large cells crowded with oil globules and representing the mature stage of the nucellar parenchyma. The embryo is of relatively large size, and is somewhat curved upon itself, so as to leave a small space on tho fumicular aspect of the seed-, cavity unoccupied, in which apparently a little true endosperm is present. The short radicle is directed to the apes, and the large cotyledons to the base of the seed.

D—Characters of female flowers in mature receptacles which have not been entered by insects.

In the majority of cases tho flowers retain the characters of those in receptacles at the stage for the access of insects, or at all events merely show modifications dependent on dentation. . That this is so comes out very clearly from *the following measurements of a* flower at this stage:—

Total height from base of pedicel to summit of ovary . . . ,	1-368 mm.
Height from base *of pedicel to origin of perianth* .	
Height from origin of perianth to summit of ovary . * . , . .	0*94 mm.
Height from upper edge of stylar insertion to summit «fA«*» . .	0*17 mm.
Breadth of ovary at level of upper edge of stylar insertion	
Length of style and stigma . . . . , ...	1*53 mm.
Diameters of ovule. . . . . ! . ' ! . ' . '	0-39 x 0.28 mm.

The only index to the occurrence of 6ontinued growth in this case lay in the fact that the tips of the lobes of the perianth were somewhat lower in respect to the summit of the ovary than they normally are at the period of insect-access. Otherwise the flower appeared merel v to have dried up.

In certain cases, however, as previously mentioned in connection with the characters of the receptacles, general enlargement of the flowers occurs, and certain of them even form achenes. The following are the measurements of a tall achene-bearino' flower:—

Total height from base of pedicel to summit of ovary.	3-73 mm#
Height from base of pedicel to origin of perianth.	171 mm.
Height from origin of perianth to bifurcation of fibro-vascular bundle.	074 mm.
Height thence to base of ovaiy.	0-08 mm.
Height of ovary.	M9 mm!
Breadth of ovary at level of upper edge of stylar insertion . . . . ,	l«08 mm,

It must be noted that this flower was one of those in which the stigma has the abnormal truncate form, and that, as is the rule in such cases, the broadest part of the ovary was not situated at the level of the upper edge of the stylar insertion, but at some distance above iV the style being inserted lower down than in the normal variety of flower.

The achenes in size and outward appearance are precisely like those in receptacles to which insects have gained access, but the outer strata of the ovary are not softened this being, as already mentioned, probably due to the fact that they have not been macerated by receptacular fluid. On closer examination the resemblance of the achenes to normal ones is found to be only superficial. Even as regards their walls, the degree of sclerosis is very imperfect, the cell-cavities of the internal epidennis remaining relatively *hrse* and their lateral branches being proportionately short. It is in their contents, however, that the great difference lies, as these show no traces of an embryo, and consist merely of a great thin-walled empty sac representing the dilated nucellus and secundine. In many cases all the cells in its walls are thin, flattened, greatly extended superficially, and almost or quite empty. In a few instances a feeble attempt at accumulation of albumen has seemingly occurred, the cells corresponding with the nucellar parenchyma showing a certain number of pale g-lobules within them. The development in such cases forms a sort of parallel to the imperfect evolution of the male flowers which, as has been already shown, sometimes occurs in gall receptacles $part from the access of insects.

Results of cultivations of the pollen of Metis Moxburghii.

A very extensive series of cultivations was carried out, both on the stigmatic surfaces of receptacles ready for insect access, and in suitable fluid media in sealed wax-cells. In the case of the cultivations of the first kind, the receptacles were divided transversely, pollen from mature anthers was smeared over the stigmatic surface of the lower half, the upper half was again fitted on and pressed into close contact, and the receptacle was then placed in a moist chamber. In the other class of cultivations, pollen-grains were immersed in a drop of fluid suspended on the under surface of the cover-glass sealing a wax-cell. The solution which gave the best results was a one per cent, one of cane sugar in water, and with this much more constant and extensive evolution of pollen-tubes occurred than in any cultivations on the stigmatic surface. One great objection to the latter was found to lie in the frequency with which growths of fungal mycelium made their appearance, the filaments having a very marked tendency to adhere to the pollen-grains, and in many cases actually penetrating and passing through them from one end to the other, so that they came to be strung like beads on a thread. Those grains which escaped in many cases germinated, emitting one or two tubes, but the growth always remained very limited. The tubes were very short, and had a great tendency to become dilated at their extremities, after which no further growth occurred (Plate IV, figs. 11, 12). In" the case of the cover-glass cultivations there was not so much liability to fungal intrusion, and the tubes grew much more freely. Here they often attained a considerable length, the protoplasm gradually travelling outwards, and frequently leaving the grain at a considerable distance behind as a mere empty shell. Ultimately, as in the stigmatic cultivations, a distal dilatation made its appearance, in which the protoplasm accumulated and from which it was finally discharged into the surrounding fluid (Plate IV, fig. 13). In some -cases in stigmatic cultivations, and more frequently in cover-glass ones, a few tubes showed a tendency to branch, but the resulting twigs always remained very short (Mate IV, fig. 13).

Notes on the life-history of the fig-insect affecting Ficus Moxburghii in Calcutta.

In the above heading the words "in Calcutta" have been deliberately introduced, because it remains uncertain whether the insect which is here related to the species is the same as that related to it in its normal habitat, and specific to it, or whether we have not to deal with a case of appropriation of an exotic host by an insect properly related to one of the figs native to the locality. There are some grounds for suspecting that this really is the case. In tho first place, it is somewhat hard to imagine how the insects, if specifically related to the tree, were originally introduced to Calcutta. They certainly could not have been normally introduced by the plants first imported, as these were not at a stage to produce any fruit. It is, of course, possible that they may have been imported in receptacles of *F. Rozburghii,* or accidentally along with other materials sent down to the Botanic Garden in Calcutta from the native habitat of the tree; but, as the life of the female insect appears to be very brief after emergence, and as the latter only occurs in detached receptacles when they have been plucked when quite mature, and then very rapidly, there are difficulties in the way of accepting this as a probable event. On the other hand, there are certain phenomena which, at all events, appear to favour the hypothesis of appropriation by insects native to the new locality. For example, during the month of October 1888 specimens of both gall and female receptacles were obtained in the Botanic Garden which had been quite recently entered by insects of the normal species, whilst, iu so far as could be ascertained, no mature gall-receptacles had been formed for a period of months on any of the trees there or in the Zoological Garden at Alipore. It appears, then, quite possible that the insect is not specifically related to the tree, but that it is either normally common to it and some other species, or properly belongs to another species, and has appropriated this on importation. Without specimens of the insect normally related to the tree in its native habitat and a complete set of all those affecting the species of figs occurring about Calcutta, neither of which have yet been obtained, it is impossible to come to a definite conclusion on the point, and it is merely alluded to here as one calling for further enquiry.*

Whether, however, the insect be native or exotic, specific to *F. Roxburghii* or common to it and other species, there is no doubt that it is a single species which affects the trees in Calcutta, and is essential to the production of mature pollen and of fertile seeds there, and that this is, as I am informed by Mr. Wood-Mason, a species of *Eupristis.* In dealing with its life-history it is convenient to take as a starting point the period when a large gall-receptacle to which individuals belonging to a previous generation of fertilized females have gained access is attaining the final stages of maturation. The first certain index to the occurrence of these is a softening of the walls of the receptacle, and a diminution in their tension connected with diminution in the supply of sap reaching them and absorption of the receptacular fluid. The walls now give perceptibly on pressure and, at the same time, their colour has changed from green to a reddish-yellow. If such a receptacle be laid open, the interior of the cavity is found merely moist, with a very thick stratum of the enlarged ovaries of the gall-flowers uniformly covering the surface, save over the centre of the ostiolar face, where a great mass of closely-packed filaments and anthers forms a conspicuous prominence. The surface is everywhere, save over the staminal prominence, stained of varying shades of madder-brown, due to deposit from the absorbed receptacular fluid; the depth of tint of various areas being, as previously mentioned, apparently related to the position of the receptacle favouring excessive deposit in some places. Sometimes, too, patches or fine webs of fungal mycelium are recognisable on some parts of the surface. The solid mass of closely appressed ostiolar bracts beneath the mass of over-arching male flowers is of very considerable thickness, even in relatively small receptacles attaining a thickness of near 0-5".

It is only for a brief period that the mature receptacles retain the above characters, for the insects begin to emerge within a short time. For some time in normal cases male insects alone make their appearance, gnawing their way out of the ovaries and crawling awkwardly about over the surface to perforate the flowers containing the females and to irapregnate the inmates. They are amber-coloured, wingless, and with very strong jaws and telescopic abdomens. Gradually more and more of them converge to the central area of the ostiolar face of the cavity and commence to attack the male flowers. With their powerful jaws they cut through filaments and anthers indiscriminately, and soon reduce the mass of male flowers

* Since the above was written I have, through the kindness of Mr. Gammie, of the Government Cinchona Plantations, obtained a gall-receptacle of JR *Roxburghii* from Sikkim, which, although not quite mature, contained insects in such an advanced stage of development as to enable it to be readily determined that the species present was unequivocally distinct from that affecting the tree in Calcutta.

to a mere heap of umber-coloured *dibria* and detached stamens, filaments, anthers, and pollen-grains. Having done so, they encounter the much more formidable obstacle presented by the plug of ostiolar bracts. Here they set to work much more methodically, no longer gnawing right and left at random, but confining their operations to the centre of the plug, through which they eventually succeed in tunnelling an evenly cylindrical channel of exit loosely filled with soft brown *débris* and struggling insects (Plate IV, fig. 24).

It is, of course, difficult to determine the precise length of the intervals elapsing between the disappearance of the receptacular fluid and the emergence of the male insects into the cavity, and from the latter to their exit from the perforated ostiolum. They probably vary considerably in different instances, especially the latter, which must necessarily be directly related to the number of male insects present. The following are the only data regarding this point which are attainable:—

1. A mature receptacle was taken in the morning. At noon male insects were beginning to emerge from the ostiolum in large numbers, and at 5 p.m. females were beginning to appear.
2. A large mature receptacle was taken in the morning. A few male insects emerged from the ostiolum during the course of the day and on the following morning, and were then followed by multitudes of females during the course of the forenoon. Here the emergence of the females was apparently delayed, due to the defective number of males present to clear the way for them.
3. A largo mature receptacle was taken in the morning. At 4 p.m. one mafe had actually emerged and others coul* be seen struggling deep down in the ostiolar tunnel. By 7 a.m. of the following morning numerous males had emerged, and females were emerging and flying off in a continuous stream, and by 9 a.m. emergence had ceased.
4. A mature receptacle was laid open by transverse division, and was found to contain a large number of free female insects and a comparatively small number of males, who were already hard at work demolishing the male flowers and beginning to attack the ostiolar plug. The ostiolar half of the receptacle was put aside under a bell glass with the open surface of the receptacular cavity upwards. Twenty-four hours later perforation of the ostiolar plug had been completed, and a considerable number of male insects had emerged from the orifice and were lying about beneath the under surface of the specimen. As there was no evidence to show that any h^d escaped over the cut edges of the receptacle, the purely reflex character of the process of tunnelling was strikingly demonstrated.

Having effected their exit, such of the male insects as escape immediate seizure by the predatory ants which are usually on the wait for them fall down from the receptacle and very soon die. Under normal circumstances the winged female insects begin to emerge from the receptacles shortly after the completion of the ostiolar tunnel, appearing for a time in company with the males, and, after these have all emerged, continuing to issue forth alone for a considerable time. But all receptacles are not alike in their insect contents. In normal cases the male insects, although by no means so abundant as the females, are yet present in sufficient numbers to secure rapid and thorough perforation of the ostiolar plug; in others they are still present, but in unduly small numbers, so that there is delay in perforation; and in a third class they are entirely absent. Where no males are present, the females still emerge in enormous numbers from the ovaries into the receptacular cavity, but, as they are incapable of perforating the ostiolar plug, they remain imprisoned, and die without ever gaining exit to the outer world. The same thing also happens when the number of males is limited and insufficient to secure completion of the tunnel of exit. The cavity then presents a most remarkable appearance, the lower part being blackened by a dense mass of crawling females, who at once begin to fly off in cloud, into the surrounding air.

When the females emerge by the normal route, they sometimes fly off directly on reaching the external surface, but often they remain for a time adhering to it drying their wings, which are clogged by the debris which have adhered to them and to the rest of the surface of the body during their outward passage. The debris consist mainly of fragments of the ... and may occasionally be found still adhering ... The number of insects escaping from a single receptacle is comparatively small, and is never sufficient to give rise to any appearance of a cloud ... the wall of the tunnels, and those who escape soon fly off. Where many large receptacles ... simultaneously, a perfect cloud of them ... of them continue for some time hovering about in the surrounding air.

in access to the cavities. They are, however, present, ... in neighbourhood of ... capable of flying ... situated at a distance of about a quarter of a mile from the Botanic Garden in Calcutta is the nearest male ones, and yet are constantly present on it.

The insects have a certain power of discriminating receptacles which are at the suitable stage, them from those which have either not attained ... The distinctive feature would seem to be in some condition of the ostiolar ... may be ... depending on the surface, of apparently ... ostiolar bracts, as ... or them ... to ... ostiolat ... entering ... suitable receptacles, running over ... again and flying ... in search of another ... While and, after ... are incapable of distinguishing gall from female ... once they are ... to enter the latter as the former. When once they ... make their way in though the solid ostiolar plug of closely appressed, overlapping, bracts, ... ness of about 0·3", and in female ones is usually some... as much as 0·43". The relative sizes of insect and ostiolar plug are shown in Plate III, fig 1.

Where insects are present in abundance, the ostiolar depressions of suitable receptacles ... frequency become crowded by masses of struggling visitors attempting to force their way down between the bracts, and casting their wings as they do so. They gradually disappear from view, and a certain proportion of them ultimately succeeds in gaining access to the receptacular cavity. Large numbers of them, however, never do so, but perish miserably between the sticky bracts, where their bodies remain readily recognisable for months—even up to the period of maturation of the receptacles—as dark brown or black strata sandwiched between the appressed surfaces of the bracts. The number of insects who eventually attain access to the cavity varies greatly in different instances, but, allowing for this, there can be no doubt that larger numbers effect entrance to gall receptacles than is ever the case with female ones. The following are the data regarding this point as recorded of a certain number of cases in which the point was specially investigated:—

1. Four young gall-receptacles were opened shortly after a large emergence of insects had taken place from mature ones on the same tree. In all of them the corpses of insects were present packed away among the ostiolar bracts; in two no insects had gained access to the cavity; in one a single insect had gained access, but the cavity was still dry; in one twenty insects had entered, the cavity contained some fluid, the ovaries were evidently enlarged, and on microscopic examination unsegmented, pedicellate ova were found within the nucelli.
2. A gall-receptacle opened and found to contain the corpses of twenty-four insects, but no fluid.
3. A female receptacle opened fifteen days after insects had been seen to enter the ostiole. Ten corpses of insects present in the cavity, the ovaries enlarged, but no fluid yet present.
4. Five female receptacles opened. All showed evident general ovarian enlargement. One contained a single insect; one four; two five; and one nine.
5. Four female receptacles with general enlargement of the ovaries opened. All of them contained several insects.
6. A female receptacle with general enlargement of the ovaries contained four insects.
7. A female receptacle full of fluid and containing about 7,000 enlarged ovaries, including well-developed embryos, showed two insect corpses.
8. A female receptacle with about 12,700 enlarged ovaries, including embryos, contained only one insect-corpse within the cavity.
9. A female receptacle with universal ovarian enlargement contained a single insect.
10. Six female receptacles with general ovarian enlargement opened. Two contained one insect; three two; and one twenty-two.
11. One nearly mature female receptacle with general enlargement of the ovaries contained three insects with one or two shrunken pollen-grains adherent to them.
12. A female receptacle with general ovarian enlargement contained one insect.
13. A female receptacle full of fluid and with general ovarian enlargement contained four insects.
14. A mature female receptacle full of normal achenes contained one insect embedded in the gelatinous coating resulting from the softening of the outer coats of the ovaries.

The above data show clearly that in the case of the female receptacles the results following access of insects are not proportionate to the numbers actually attaining entrance, and that the entrance of a single insect is sufficient to determine general ovarian enlargement aud the development of thousands of embryos. The latter fact has been brought out very clearly in certain special cases. In the first of these a receptacle into which a single insect had gained access was used as the source wheuce materials for sections and dissections of the ovaries at an early stage of enlargement were obtained, and in all cases embryos w the earlier stages of evolution were readily recognisable; in the second over eleven thousand achenes from a mature receptacle containing only one recognisable insect were sown and yielded an enormous crop of seedlings.

Those insects which succeed in forcing their way into- the receptacular cavities immediately set about attempting to deposit their ova within the flowers. They move actively about over the surface from one flower to another, and in the case of gall-receptacles rapidly get rid of their ova, and then die. The site of deposition is invariably within the nucelliis between the epidermis and the loose parenchyma, and at a level with, or a little beneath, the site of attachment of the funicle, and therefore* at some distance beneath the level of attachment of the base of the style (Plate IV, figs. 14,16). The deposition must apparently take place, not *vid* the style, but by means of penetration of the upper surface of the ovary. The external ovipositor is certainly too short to reach even the base of the style in many cases' but, without definite information regarding the length to which the internal portion can be protruded beyond it, this cannot be regarded as evidence of any great weight in regard to the question. The really important evidence lies in the structural features of the flower as these show that a very much more direct route to the site of deposition is present from the summit of the ovary than from the stigma, and one, too, in which the amount of solid tissue to be penetrated is very much less than in the case of the stylar route. This is shown very clearly by the following measurements: —

1. Distance from superior surface of ovary to site of deposition—

Thiokness of ovarian wall.	.0#04mm.
Depth from interoal surface of ovarian wall to micropyle, which lies immediately below	.002mm.
Depth from micropyle to level where the seoundine becomes closely adherent to thenuoellus.	.006mm.
Depth thence to site of deposition.	.QQ4
Total depth from surface of summit of ovary to site of deposition.	.0*16
Depth of really solid tissue to be penetrated.	*.QQ$*

2. Distance from inferior extremity of stylar canal to site of deposition-

Depth of solid portion of style from lower end of stylar canal to inner side of inner stratum of ovarian wall.	.0*16 mm.
Depth thence to site of deposit.	.0*08 mm.
Total depth of solid tissue to be penetrated.	.*Q* g^

It is evident from the above figures that the stylar route reckoned from the lower extremity of the stylar canal is one-third longer than the other one, and includes three times as large an amount of solid tissue as it does (Plate IV, fig. 19). It is, moreover, much more indirect, as will be clearly evident on reference to the drawing, for the upper surface of the ovary lies vertically over the micropyle and the site of deposition within the nucellus, whilst the lower end of the stylar canal is situated far to one side of the latter. *It* does not thus appear to be the different form of the stigma and style in normal female and gall-flowers, which permits of the deposition of ova in the latter and prevents it in the former. The real determinant is, no doubt, the very great difference in the character and thickness of the ovarian walls in the two cases. Over the summit of the ovary in gall-flowers the wall is only about a third as thick as it is in the corresponding site in female ones (Plate V, figs. 1, 22), and it is throughout composed of thin-walled cells which may readily be penetrated, whereas in the case of the female flowers the outer and inner epidermal cells have relatively strong walls, and there is, in addition, a stratum of very dense tissue consisting of the layer of small cells immediately external to the internal epidermis.

The ova as expressed from the bodies of the insects and as occurring within the nucelli of recently-entered receptacles vary conspicuously in characters. As obtained from the bodiejTdT tne insects, wiey me iuui« «» U,,, -^-^^,^ —1^-j ;___j — ^-U^_L_J^"-- -- * 0-06 mm., a conspicuous nucleus and beautifully reticulate protopTasmTplate IV fie" l»f whereas within the nucelli they are of elongated oval form, contain a dense solid mass of protoplasm concealing the nucleus, and are provided with a long pedicel which serves to attach them to the neighbouring tissues (Plate IV, fig. 17).

Although no ova can be deposited within the true female flowers, the insects which mistakenly enter female in place of gall-receptacles do not appear to realise the fact and go on perseveringly traversing the surface and attempting to effect perforation until'they become exhausted and die, their corpses remaining readily recognisable for a long time and their heads, especially, regaining well preserved even to the time of maturation of the receptacles.

Other insects especially related to the receptacles of F. Roxburghii.

No other insects, of course, are so essentially related to the receptacles as the species described above, but there axe several others which are closely associated with them. The first of these, which is probably a species of the Tineina according to Mr. Wood-Mason inhabits the receptacular cavities during its larval stage, feeding on the flowedandZl mately eating its way out through the ostiolum. The affectedven^i but fall soon after the emergence of the insect, and the futbtTtaTJST "? aborted is very considerable, especially, in the case of female W Thl "*, are also specially related to the receptacles. These are 1st tZn br own T" *** which Mr. Wood-Mason informs me is probably P^oU LZ^[f ^J9TM**, T 1 ^ Fabr, and 3rd, 8ima ^ *JJT£ £pecie* * ^ , ...cophylla mature female receptedes as formicaries. There is no conspicuous perforation' or other\ xternal sign to mdicate their presence, but on opening an affected receptacle the caXI found to be occupied by a small colony of the mature insects with an abundance of young ones in yanous stages of development spread out over the gelatinous surface. On one Z an affected receptacle aiter div.s.on was kept for some days under observa^on^Z young were very soon carried down out of sight into cavities in the pulp L th! mature insects made excursions out over the table to pick un anv soatt<LT ! anu carry them home. The association of *(Ecoph.Ua snlagtoj* ™*l* S ^ L r ? due to the fact that the figWt serves as a great Zource *T J t ^ T* ^ been already pointed out, the occurrence of maturation in the gall-recentaeW ^ the approaching exit of the fig-insects can very frequently be mdilydetected for\orne time ere emergence actually sets in, due to the presence of parties of th« . • * ant washing vigilantly around the ostioles and finely *n j £ Z ? £ l g 7 £* receptacles. As it appears to be impossible that they should be able to appreciate *II* diminished tension of the thick receptacular walls consequent on the disappearance of

the fluid from the cavity during maturation, it is probable that they ascertain the approaching exit of the fig-insects by hearing the gnawing of the males among the ostiolar scales, or by tactile sensation of the vibration of tissue connected with it. In any case they are there in waiting, and, as soon as the fig-insects begin to emerge, at once proceed to seize and carry them off, peering down into the canal of exit and often reaching down into it to secure insects which have not yet fairly emerged. So long as the number of maturing receptacles is not excessive in relation to the number of ants present, the latter are contented to carry off their prey to their nests on other trees; for, under ordinary circumstances, there are none on *F. Roxburghii,* due, no doubt, partly to the inconvenient strength and resistance presented by the leaves rendering them difficult to manipulate, but mainly to the fact that the tree is not liable to be infested by aphides or scale-insects, the presence of which is the ordinary determinant of the location of the nests. The nests, during a great part of the year at all events, are mere cow-houses, and it is only during the rainy season that young are to be found in them. When, however, an excess of receptacles mature simultaneously, the ants construct nests locally, managing in a wonderful fashion to bend the large, stiff leaves and secure their edges by the usual tough, papery web used in nest building elsewhere, and proceed to accumulate large numbers of corpses in these local larders.

Sirna rufonigra also utilises the fig-insects as a source of food-supply, but is not nearly so constant or methodical in its attendance as the previous species is, due, no doubt, to the great abundance of the latter, and the ferocity with which any interference with its rights is resented. In fact, as a rule, ants of this species are only found on trees not visited by *CEcophylla,* or only after the latter has left the receptacles on the cessation of emergence of fig-insects from them. In the latter case they frequently enter the receptacular cavity to pick up the bodies of insects which have died without emerging.

Conclusion.

It remains now to consider certain points regarding the relation which the presence of the fig-infeect holds to the fertilization of the receptacles of *F. Boxburghii.* There can be little room for doubt that the phenomena indicate that, while the development of embryos in the female receptacles of the tree if essentially connected with the access of the insects to the receptacular cavity, it is yet normally independent of the introduction of pollen by their agency. The fact that the access of a single insect or of a pair of them only is sufficient to determine the development of ten or twelve thousand embryos, is in itself almost conclusive against the occurrence of any ordinary process of pollination. The obstacles through which a passage has to be forced ere the receptacular cavity is reached are of such nature and amount as to render it almost inconceivable that pollen should be introduced in sufficient quantity (Plate III, figs. 1, 2), and there is at the same time an absolute want of evidence to show that such introduction takes place. I have carefully examined very many recepracles at various periods shortly after access of insects to the cavities, and have never been able to detect any evidence of general distribution of pollen over the stigmatic surface. Examination of individual flowers has given like results; in most cases it has been impossible to find any pollen within the receptacle or cavity, and in the few cases in which any was found it was represented by one or two shrivelled grains adherent to the corpses of insects. It must be borne in mind, too, that if we accept the hypothesis that the development of the embryos is due to ordinary processes of pollination, we must assume not only that a single insect can convey many thousands of pollen-grains with it in spite of the excessive obstructions to access presented by the ostiolar plug, but that these grains are also most methodically and economically distributed, for, unless each stigma were only allowed to appropriate a single grain, the amount introduced would have to be indefinitely multiplied.

The occurrence of ordinary pollination thus appears to be impossible, and the only way in which a sufficient number of pollen-tubes could be reasonably supposed to originate would be by means of peculiarities in their development, the primary tubes originating from the grains having a capacity for indefinite growth and ramification, so as to give rise to mycelioid expansions from which branches might be distributed to the individual stigmata. There is, however, no evidence of the actual occurrence of any such phenomenon. There is nothing to show that the tubes, whether developed within the receptacular cavities or as the result of artificial cultivations in suitable media, have any special tendency to branch, far less that they have any capacity for indefinite mycelioid extension.

The most important evidence against the occurrence of pollination of any sort as a normal and essential event lies, however, in the fact that the embryo originates, as it does in undoubted cases of development, apart from pollination. The embryo, as a rule—for of course it is possible that pollination and normal evolution may occur in certain individual flowers-certainly arises as an outgrowth of the nucellar parenchyma outside the embryo-sac, and not as the result of special evolution of auy elements contained within the latter. The embryo-sac up to the period of insect-access and of initial development of the embryo normally retains the characters of a simple, uninucleate cell. There is no evidence of the formation of an oosphere, of synergida, or of antipodal cells within it, and it is only subsequent to commencing evolution of the embryo that the primary nucleus is replaced by a large number of secondary ones which are apparently related to the elaboration of food material for the growing embryo when it gains access to the cavity of the sac.

But if pollination be not necessary, why should the access of insects be essential to the development of embryos? The phenomena presenting themselves in connection with the male flowers of gall-receptacles appear to afford a clue to answering this question. It is just as impossible for the male flowers to come to perfection-just as impossible for perfect pollen-grains to be developed without the access of insect to the gall-receptacles-as it is for embryos to be developed in female ones under parallel circumstances. In the case of the male flowers, however, it is clear that the production of pollen ... cannot be the essential determinant of development, but that ... to something else connected with the access of the insects. It is not ... the insects that determines the perfect evolution ... to effect which their ... the receptacle that the evolution becomes possible. The result of the access of the insects, of the puncture of the gall-flowers and deposition of ova in the interior of the nucelli, is the induction of great irritative stimulation to the activities of all the tissues of the receptacle. The mass ... receptacular ... undergoes hypertrophic changes similar to those occurring in the development of any common gall-growth, and connected with their occurrence an enormously increased flow of sap to the receptacle takes place, as indicated by the accumulation of fluid under high pressure within the receptacular cavity, and the abundant escape of latex on division of the peduncle or incision of the surface.

The maturation of the male flowers is, then, clearly a result of general irritative hypertrophy of the receptacular tissue as a whole, due to insect access, and not the result of the addition of any extraneous bodies to them; and when the rest of the evidence is taken into account, there can be little doubt that the phenomena presenting themselves in connection with the true female flowers are of essentially similar nature and origin.

It may be objected that in the case of the female receptacles no deposit of ova within the tissues takes place, and that, therefore, a source of irritative stimulation of sufficient magnitude is wanting. But although no ova are successfully deposited within the ovaries of the true female flowers, owing to the strength and thickness of their walls, this by no means implies that attempts at deposit are not made. On the contrary, as has already been pointed out, the insects which attain access to female receptacles go on perseveringly attempting deposition until they are worn out and die; or, in other words, they go on perseveringly stinging the ovarian tissues as long as their life lasts. But it is the process of perforation, which is probably the real determinant of hypertrophy in the gall-receptacles, and not the mere deposition of the ova, which profit by its presence. The essential stimulus is thus alike in both cases; and this being so, parallel results naturally follow, and maturation of polle^grains in the male flowers and embryogenie growth of a specialised portion of the nucellar tissue in the female ones take place.

While this is so; while the development of embryos as a rule occurs independently of pollination, it is of course possible that exceptions may occur, and that the embryogeny of certain flowers may take place in the normal fashion; and it is even possible that the embryos arising in this way may have a stronger vitality, and therefore more chance of ultimate survival, than the others: but if this be the case, it can only be so as an exceptional phenomenon, for among the hundreds of ovules which I have? examined I have never seen anything suggestive of its occurrence.

The development of embryos in *F. Bozlurghii,* then, appears normally to be an asexual process dependent on hypertrophic budding of a specialised portion of the nucellar parenchyma, and it appears not improbable that the phenomenon is not peculiar to the species, but is the rule in the case of other figs also. This, of course, requires further investigation; but in the only instance in which I have yet had time to examine the matter—in the case of *F. hispida*—there can be no doubt that it is so.

In conclusion, I have to express my obligations to my friends Dr. George King and Dr. Gerald Bomford: to the former for having first directed my attention to, and supplied me with materials for the investigation of the subject dealt with in the previous pages, and to the latter for a very fine set of serial sections of ovules from receptacles before and after insect access.

D. D. CUNNINGHAM.

November 1888.

DESCRIPTION *OF* PLATES,

PLATE I.

Fig. 1. Mature galled male receptacles. Almost natural size.
Fig. 2. . Ditto ditto ditto; one divided and showing the receptacular cavity.

PLATE II.

Kg. 1. Mature male flower, showing sheathing bract, bilobed outer perianth, inner perianth ruptured superiorly, stamens, and rudimentary female organs. . . . . x 10*5
Kg. 2. Pedicellate gall-flowers from a receptacle ready for insects. . . . . x 37
Fig. 3. Pedicellate gall-flowers containing insects from an almost mature receptaole. . . . . x 37
Fig. 4. Sessile gall-flower from a reoeptaole ready for insects. . . . .' . . x 42
Fig. 5. True female flowers from a reoeptaole ready for insects. . . . . x 25
Fig 6. Pedicellate female flower stained with picrocarmine from a receptacle ready for insects, showing perianth, division of axial fibro-vascular bundle, funiole, and ovule . • . x 42
Fig. 7. Mature female flowers containing ripe aohenes. . . . . x 25

N.B.—Figs. 4 and 6 are from permanently mounted covered specimens; figs. 1, 2, 8,5, and 7 from fresh uncovered ones.

PLATE III.

Fig. 1. Vertical section through the ostiole of a female receptacle ready for inseofcs, showing the thickness of the solid plug of overlapping ostiolar bracts and the relative size of the female fig-insect. . . . . x 10-5
Fig. 2. Vertical section of a female receptaole ready for insects. Natural size.
Fig. 3. Transverse section of a female receptacle in which a certain number of the ovaries have become enlarged independent of access of insects. Natural size.
Fig. 4. Flowers and part of the receptaoular wall of a mature female receptacle. . . . . . x 10-5
FiS- 5- Ditto ditto ditto female receptacle ready for insects • . . x 10*5
Fig. 6. Mature female reoeptaole. Natural size.
Fig. 7. Transverse section of a mature female reoeptaole. Natural size.

PLATE IV.

Fig.'l. Male flowers : *a*, nearly mature, inner perianth divided and reflected to show position of stamens and rudimentary female organs; J, position of stamens in a fully mature flower.
Fig. 2. Upper part of nearly mature male flower with naturally ruptured inner perianth still surrounding the folded filaments . . . « • • «. . . . . x 25

Fig. 3. Highly developed rudimentary female apparatus of a male flower. . . . . . . x 25

Kg. 4. State of stamens in the male flowers of mature reoeptaoles to which insects have not gained access, but in which a oertain amount of evolution has occurred beyond the stage present at the normal period for access, showing a certain wnount of development of the anther-lobes.

Fig. 5. Transverse section through an anther-lobe of suoh a stamen, showing masses of pollen-tetrads, tapetal cells, and stratum of fibres. . . . . x 119

Fig. 6. Isolated pollen-tetrads from suoh a stamen. . . . . x 590

Fig. 7. Mature pollen-grains stained with piorooarmine, showing nuclei. . . . . x 690

Fig. 8. Sheathing bract of a male flower at period for access of insects to the receptacle.

Fig. 9. Mature pollen-grain, fresh. . . . . x ggQ

Fig. 10. Various appearances presented by pollen-grains in one per cent, solution of cane sugar . x 850

Fig. 11. Germinating pollen-grains from cultivations on the stigmatio surfaces of reoeptaoles . x 690

Fig. 12. Ditto ditto ditto ditto . . x 500

Fig. 13. Germinating pollen-grains from one per oent. solution of cane sugar. . . . . . . x 690

Fig. 14. Ovule of a gall-flower from a receptacle shortly after access of insects, showing intranuoellar site of insect ovum; stained with piorooarmine. . . . . x 42

Fig. 15. Ape* of similar ovule, showing tendenoy to formation of an apical cap in the nuoellar parenchyma. . . . . x 119

Fig. 16. Portion of a similar ovule, showing site of insect ovum between nuoellar epidermis and parenchyma. . . . . x ^g

Fig. 17. Inseot ovum, and portion of nuoellar parenohyma from a similar ovule . . . . x 370

Fig. 18. Ovum as expressed from the body of a female inseot. . . . . x 370

Fig. 19. Vertical section through a gall-flower from a receptacle ready for the access of insect's . x 119
o.s, stylar canal; p, solid base of style ; 0, wall of ovary ; f .v, branches of axial fibro-vascular bundle; s, seoundine ; e.n, nuoellar epidermis ; i.n, nuoellar parenchyma ; 6, site of deposit of ovum.

Fig. 20. Inner stratum of cells of membrane surrounding the body of an embryo insect within the ovary of a gall-flower. x 370

Fig. 21. Section of gall-receptacle ready for insects. Natural size.

Fig. 22. Ditto ditto ditto.
a*, area occupied by male flowers ; b, area occupied by ostiolar bracts; o, c, area of gall-flowers.

Fig. 2a Section of gall-receptacle which had matured without access of insects. Natural size.

Fig. 24. Portion of a mature galled receptacle after escape of the fig-insects, showing tunnel through ostiolar plug.

Fig. 25. Section of ovarian wall from an almost mature gall-flower containing an insect . . . x 370

Fig. 26. Portion of a mature ungalled gaU-reoeptaole showing thickness of stratum of gall-flowers. Natural size.

Fig. 27. Portion of a mature galled receptacle, showing tiers of ovaries and uneven reoeptacula.

PLATE V.

Fig. L Vertical section through the apex of the ovary of a teue female flower from a female receptacle ready for the access of fig-insects, showing the different sZl ofTe ovanan waU, the seoundxne. the nuoellar epidermis, and its apical thiTJng in the m^pyle, the nucellar parenchyma with its apical tirfckLg and 3 genie cell, and the upper part of the embryo-sac; stained with logwood . x 370

Fig. 2. Portion of vertical section of the apex of the ovary of another flower at the same stage, shown* a portion of the apical cap of nuoellar parenchyma, the embryogenic cell, and apex of the embryo-sac . . . . wuiujrugwiiu
. . . . x 690

Fig. 3. Portion of the next serial eeotion of the same ovary as that of figure 2, showing apioal eap of nuoellar parenchyma, embryogenio cell, and embryo-sac, with its nucleus. . . . . x 370
Pig. 4. Portion of another ovary. . . . . x 690
Kg. 5. Ditto ditto. . . . . x 370
Pig. 6. Ditto ditto showing attachment of embryogenio cell to the under surface of the apical cap of nucellar parenohyma.
Pig. 7. Portion of the base of an ovary, showing basal thickenings of nuoellar epidermis and parenchyma from a female flower in a receptacle ready for insects. . . . . . x 370
Pig. 8. Ovule from a female flower of a receptacle ready for insects, showing raphe, secundine, and nucellar epidermis and parenohyma, with basal and apioal thickenings; stained with piorooarmine. . . . . x 42
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Pig. 12. Commencing evolution of the pro-embiyo within the enlarged embryogenio cell . . . x 690
Pig. 13. Upper part of the embryo-sao of a flower from a reoeptaole shortly after access of insects, showing the mark on the apex of the sac corresponding with the under surface of the enlarging embryogenio oell; also the persistent primary nucleus. . . . . . x 370
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Pig. 18. Vertical section through the wall of a ripe aohene ; stained with gentian violet . . , x 370
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Pig. 20. Hypodennal cells of ovary of mature female flower; stained with gentian violet . . . x 160
Pig. 21. Portion of vertical section of the base of an ovule of a female flower from a receptacle shortly after aooess of inseots ; stained with piorooarmine. . . . . x 370
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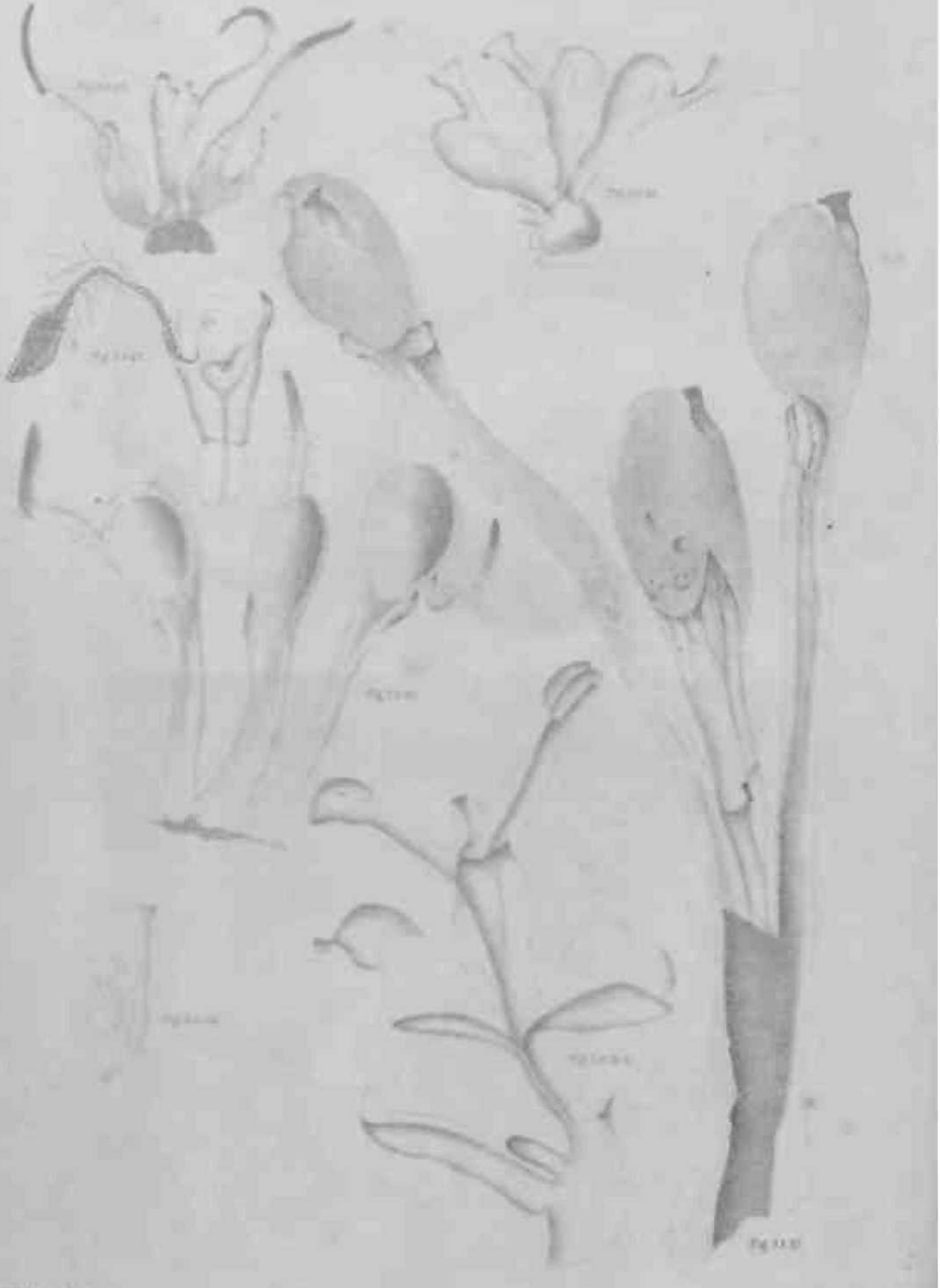
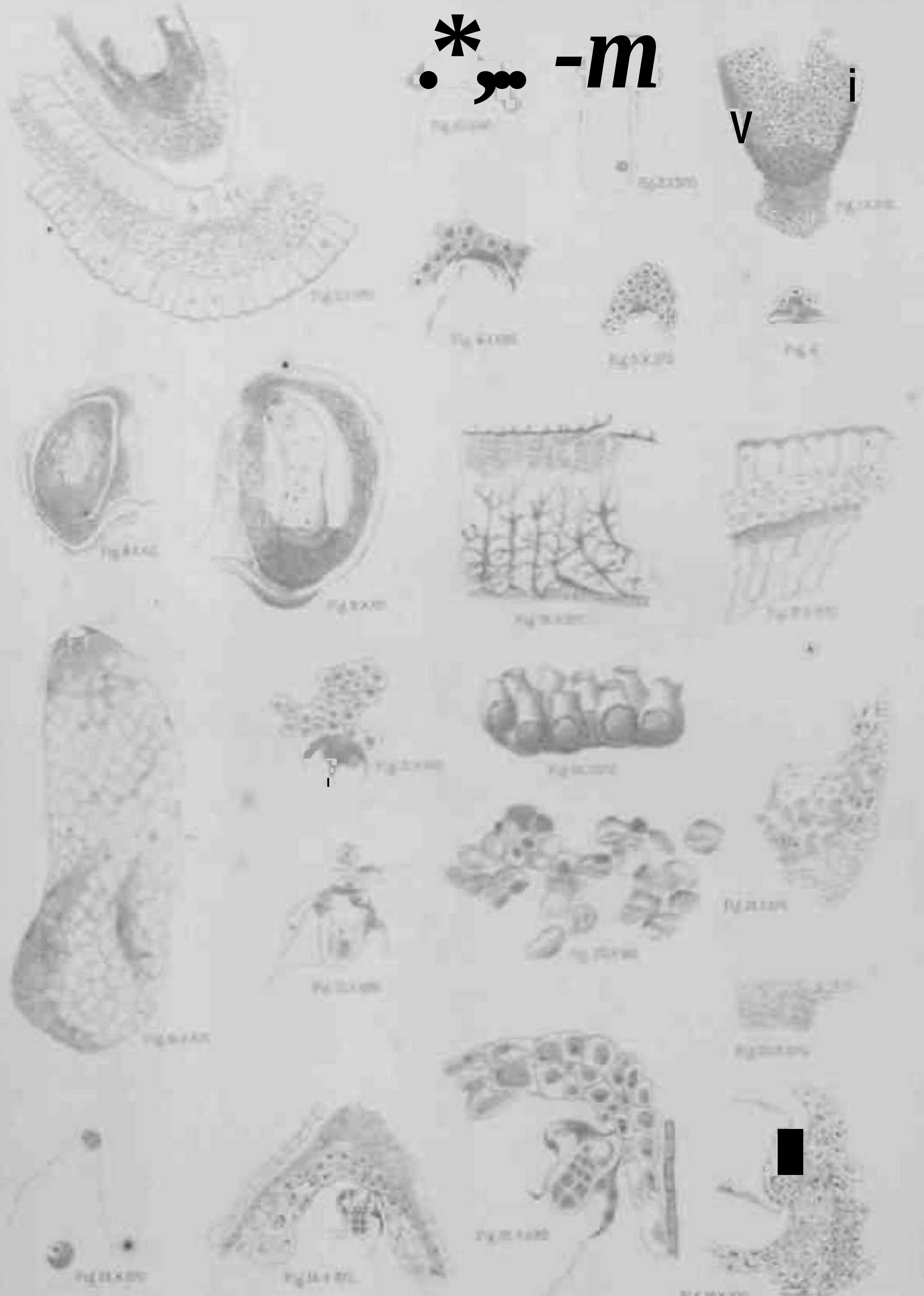
W. H. D'C.-Beg. No. 11921J-360-27-4.89.

INDEX TO APPENDU



[illegible] NORMAL FEMALE AND GALL-FLOWERS IN VARIOUS STAGES OF DEVELOPMENT.

PLATE V



Lith. by A.C. [illegible] Govt. School of Art Calcutta

DETAILS OF STRUCTURE OF OVARIES AND OVULES BEFORE AND AFTER ACCESS OF INSECTS TO THE RECEPTACLES

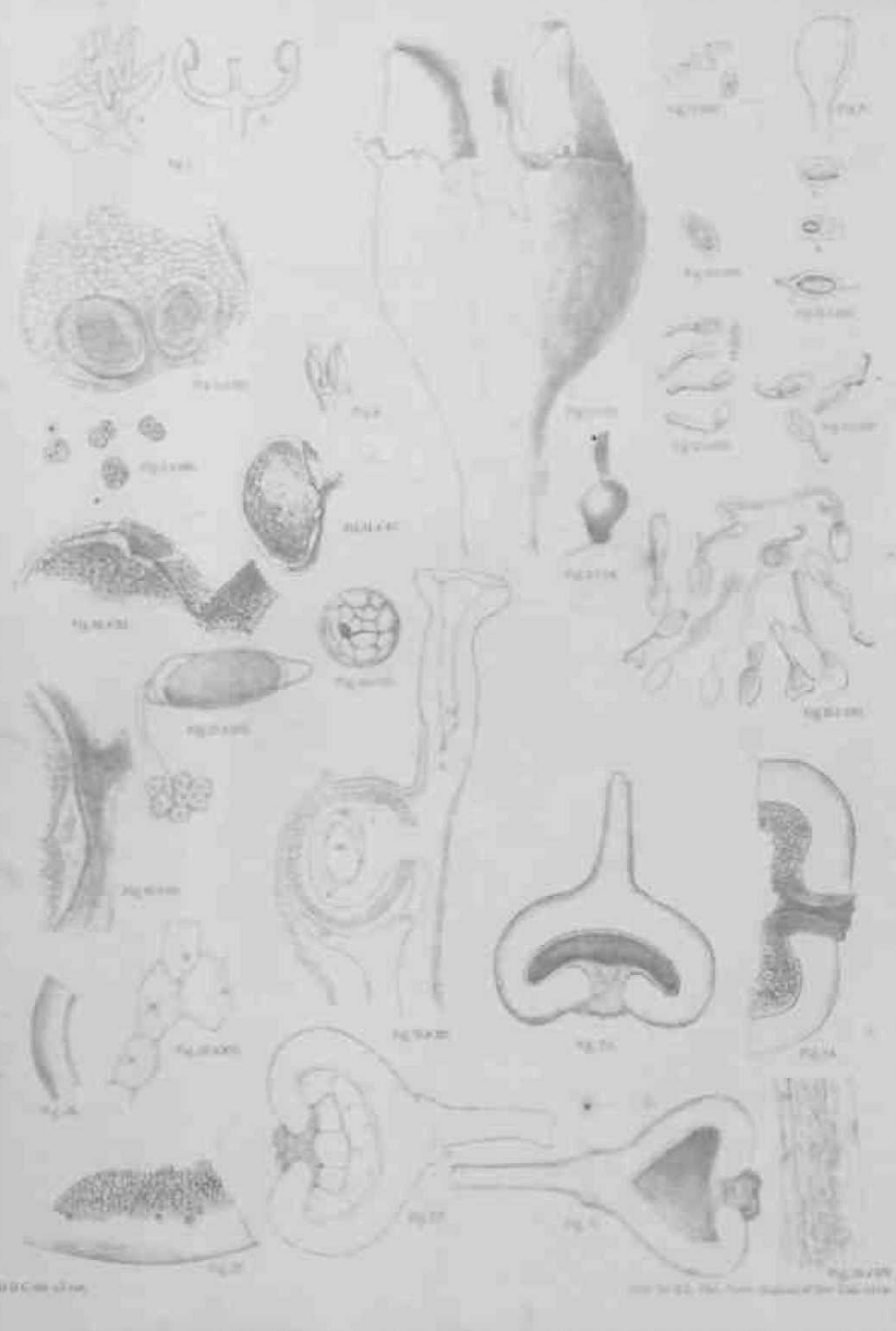
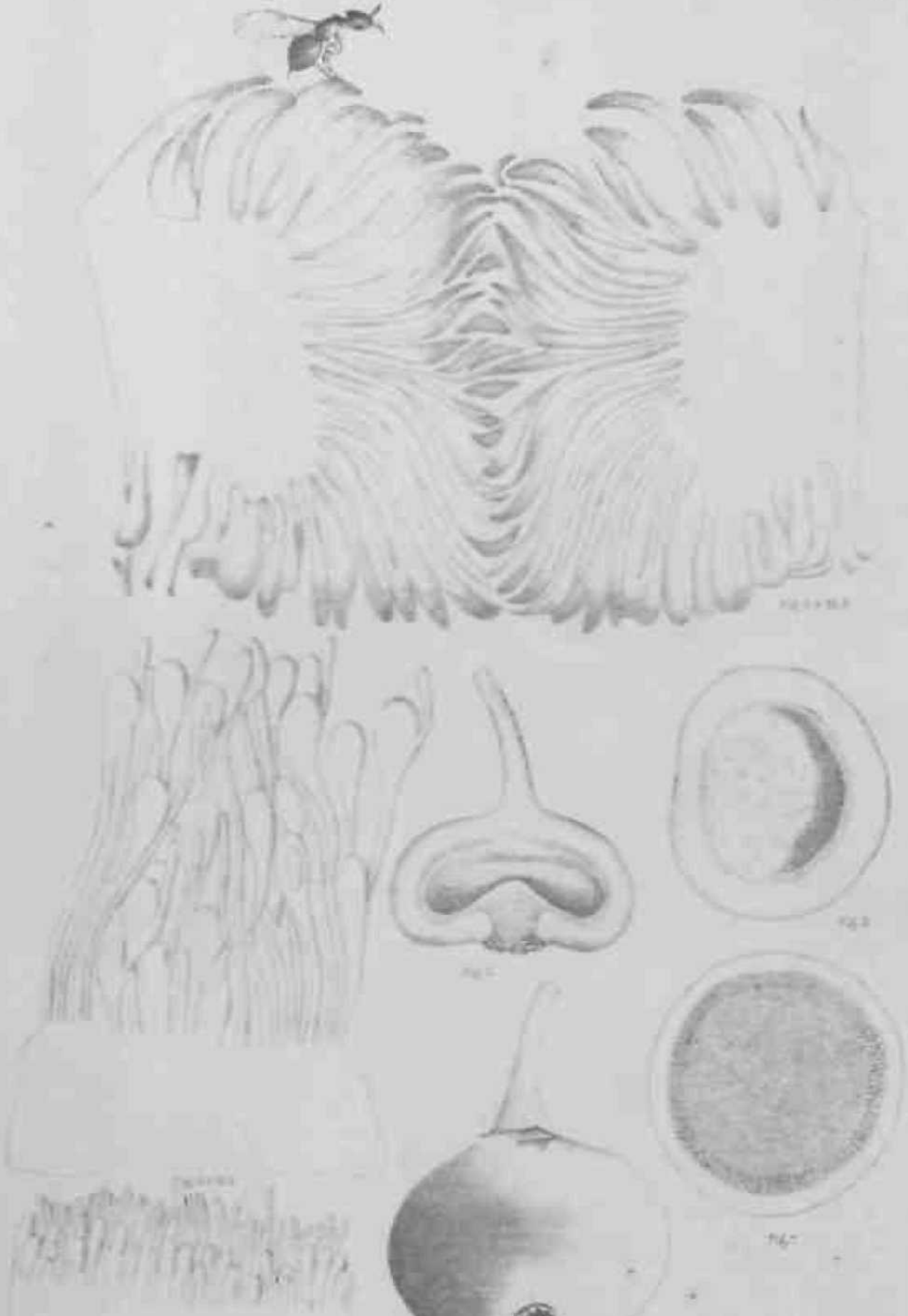
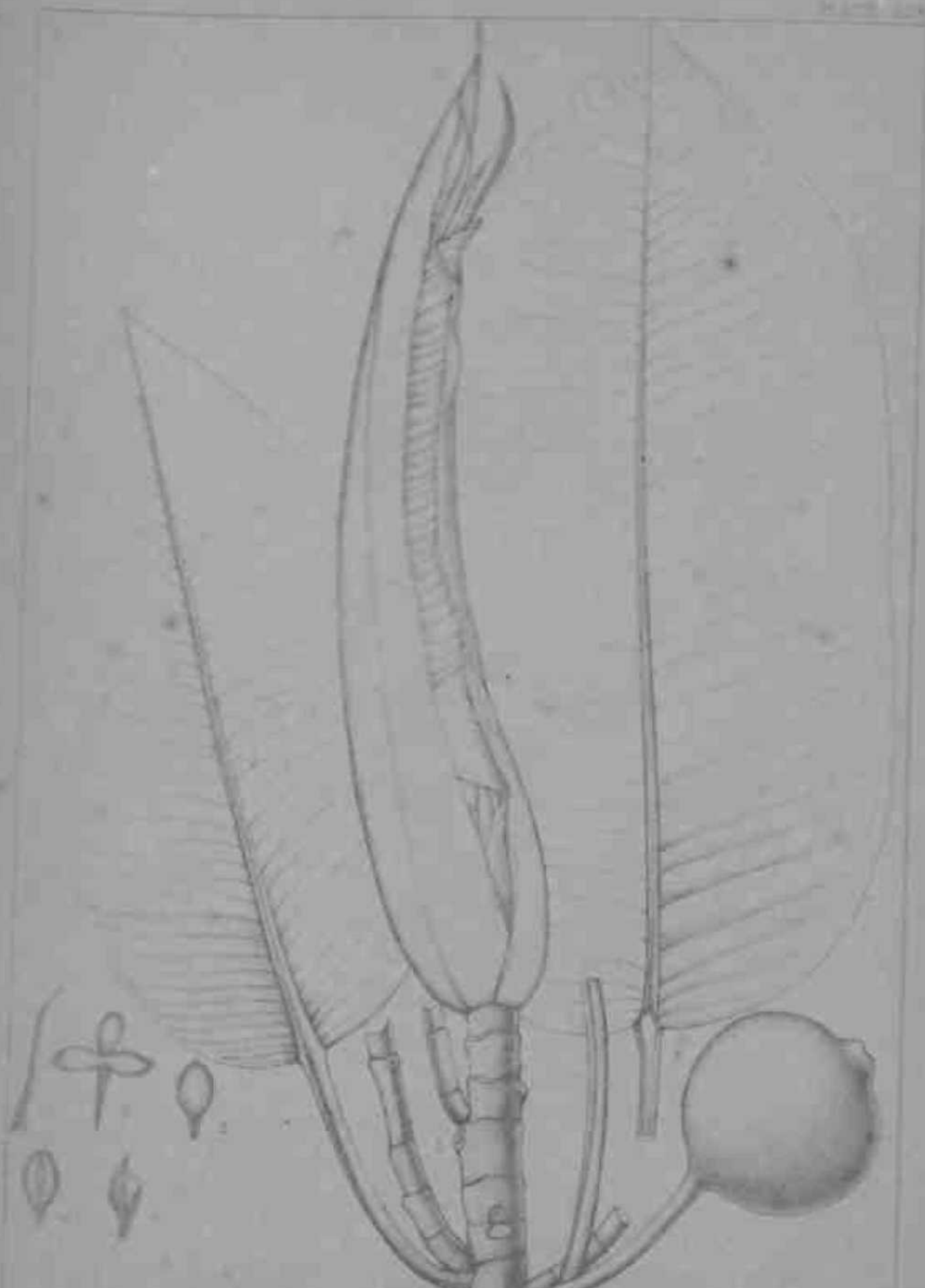


PLATE III.



FEMALE RECEPTACLES AND FLOWERS AT DIFFERENT STAGES OF DEVELOPMENT.



FICUS HESPERIDIIFORMIS King.

PLATE I.

Fig 1

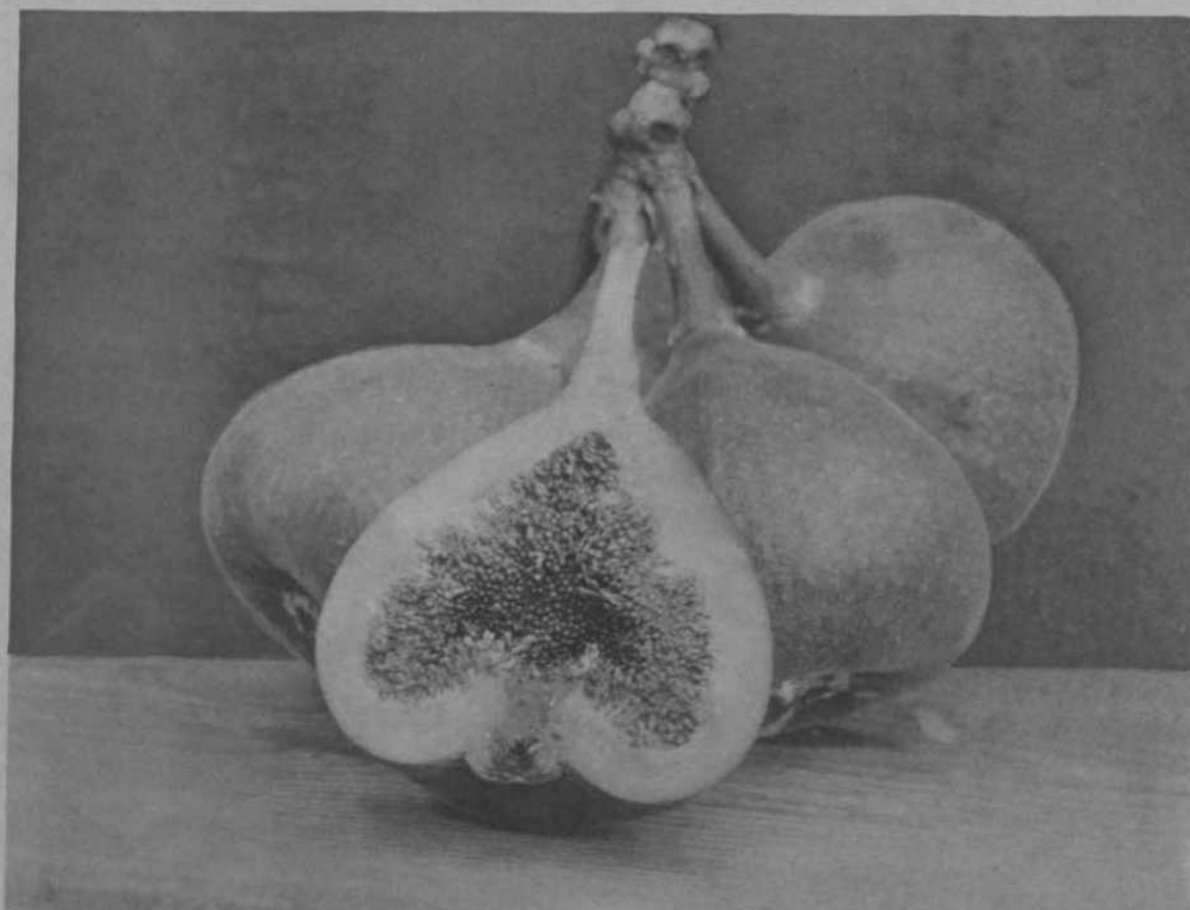


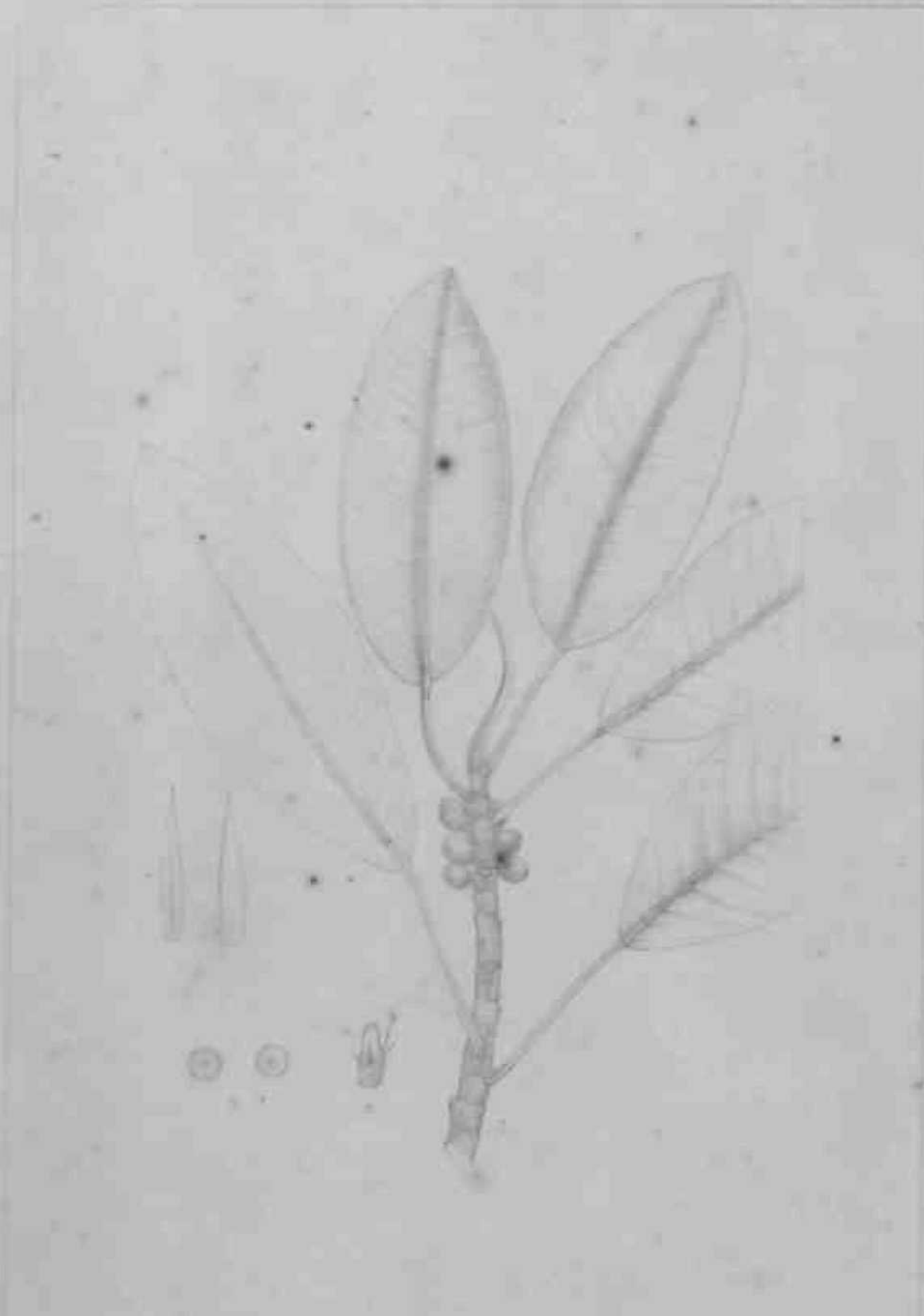
Photo-etching

Fig 2

Survey of India Offices, Calcutta, March 1907

FICUS ROXBURGHII, WALL.

Mature Galled Male Receptacles



PLATE

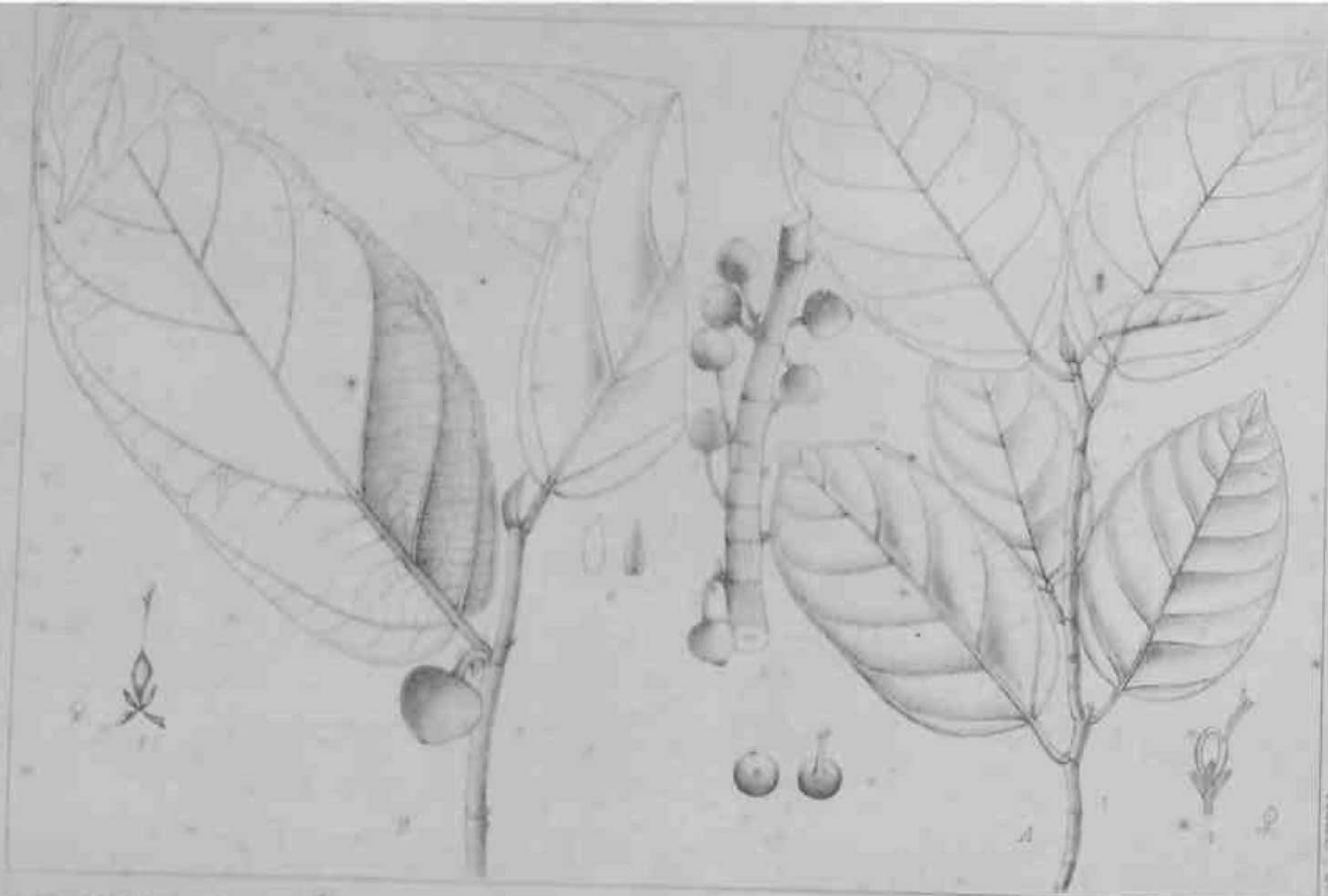


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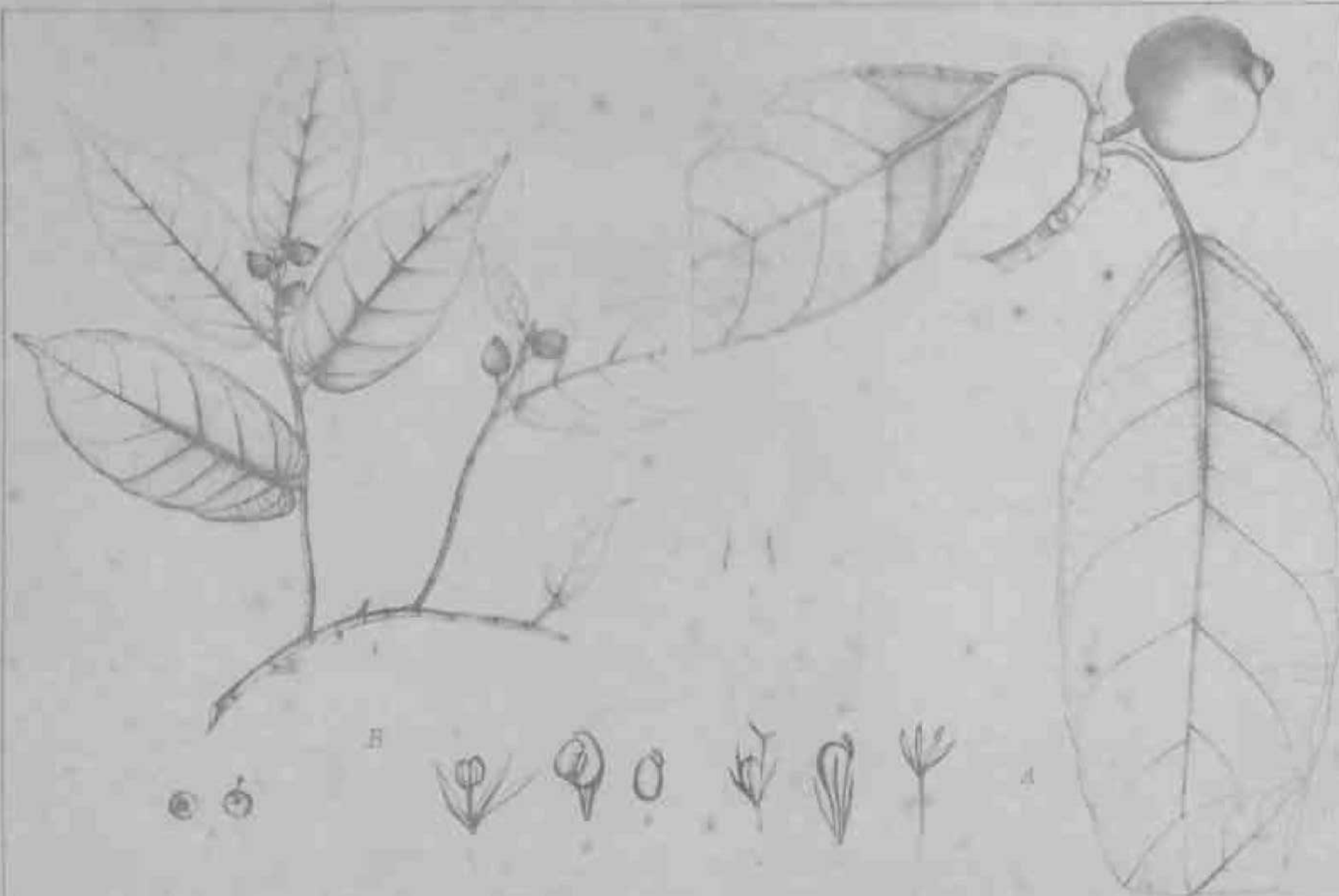
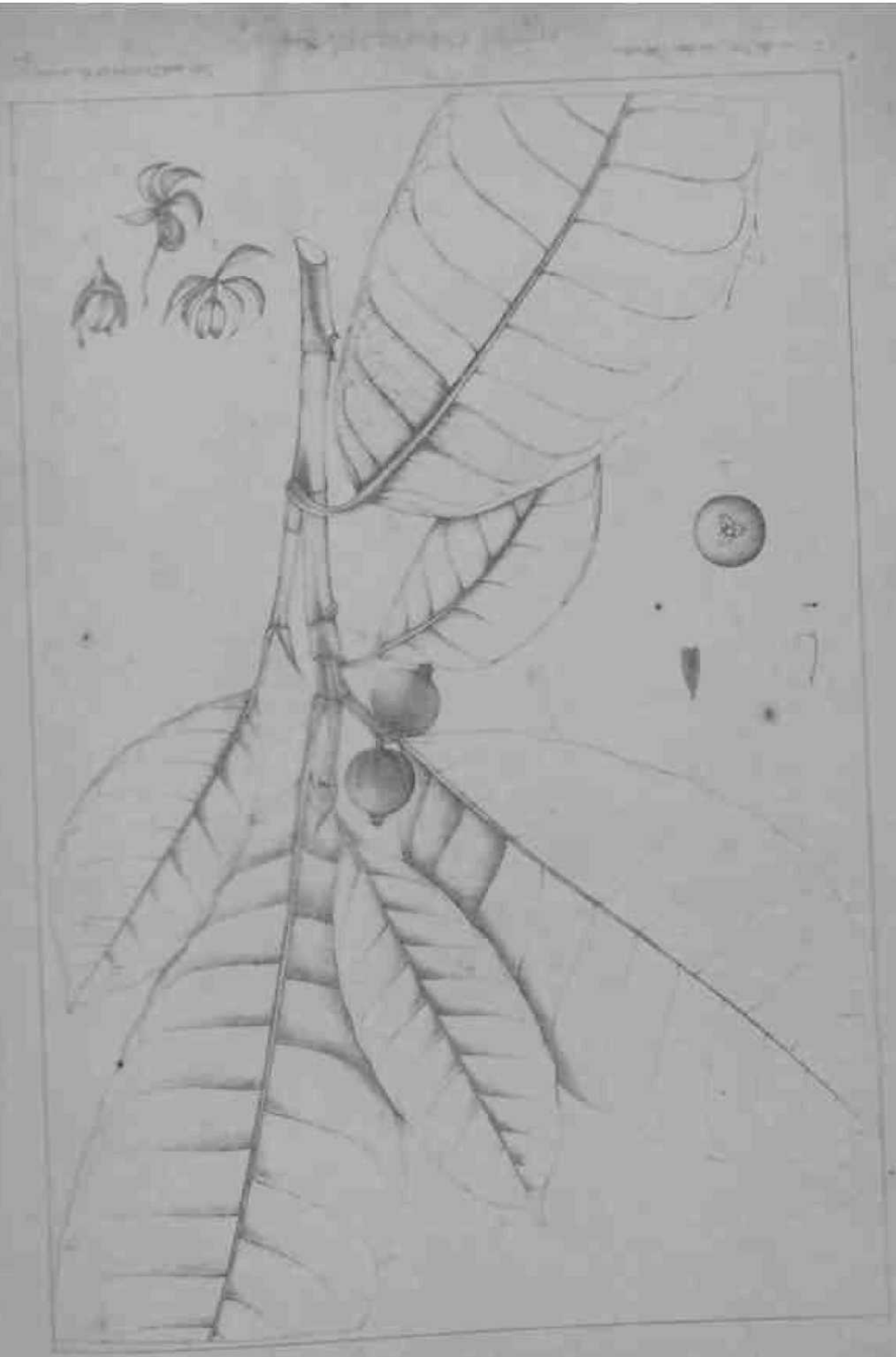
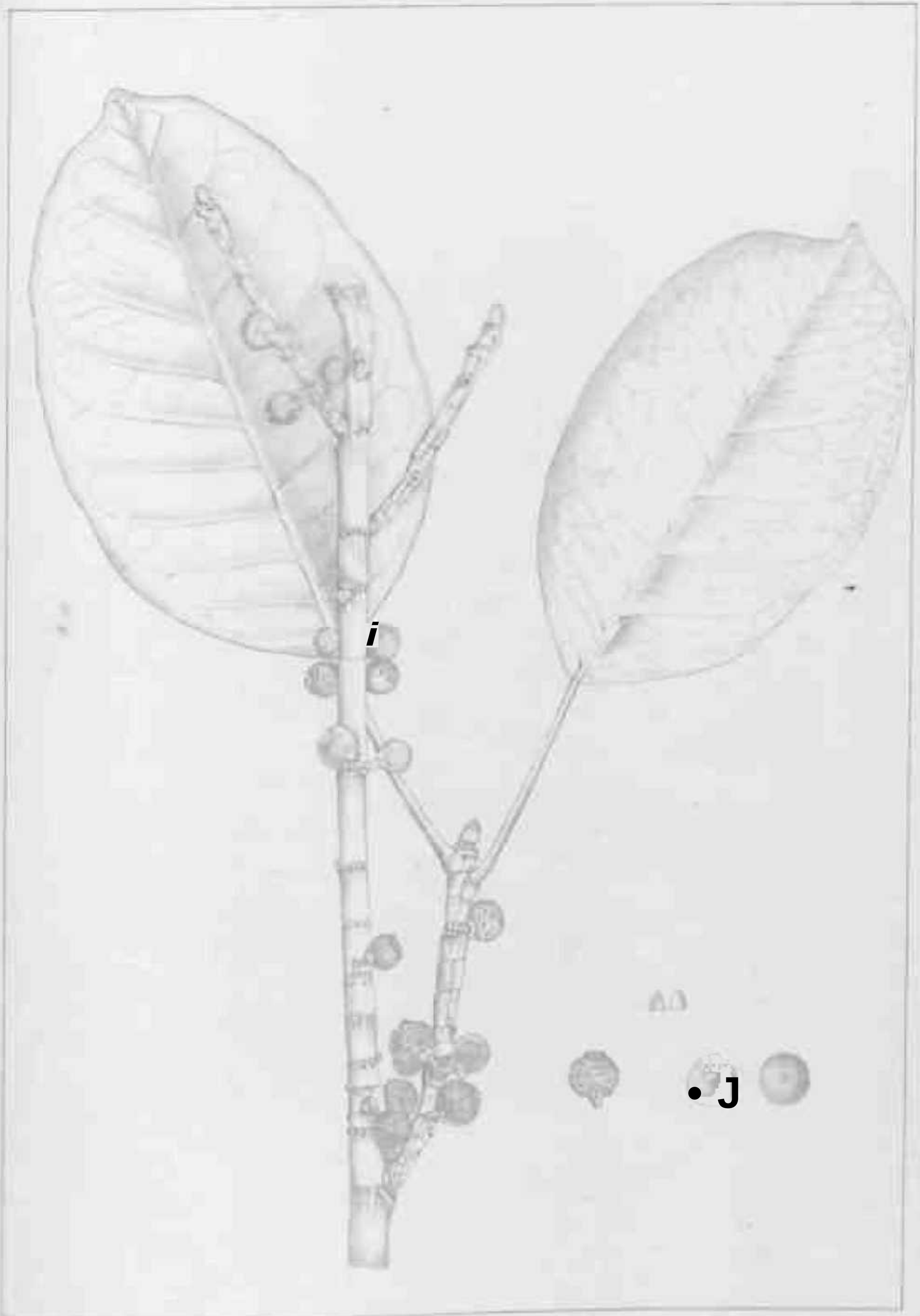
PLATE 23



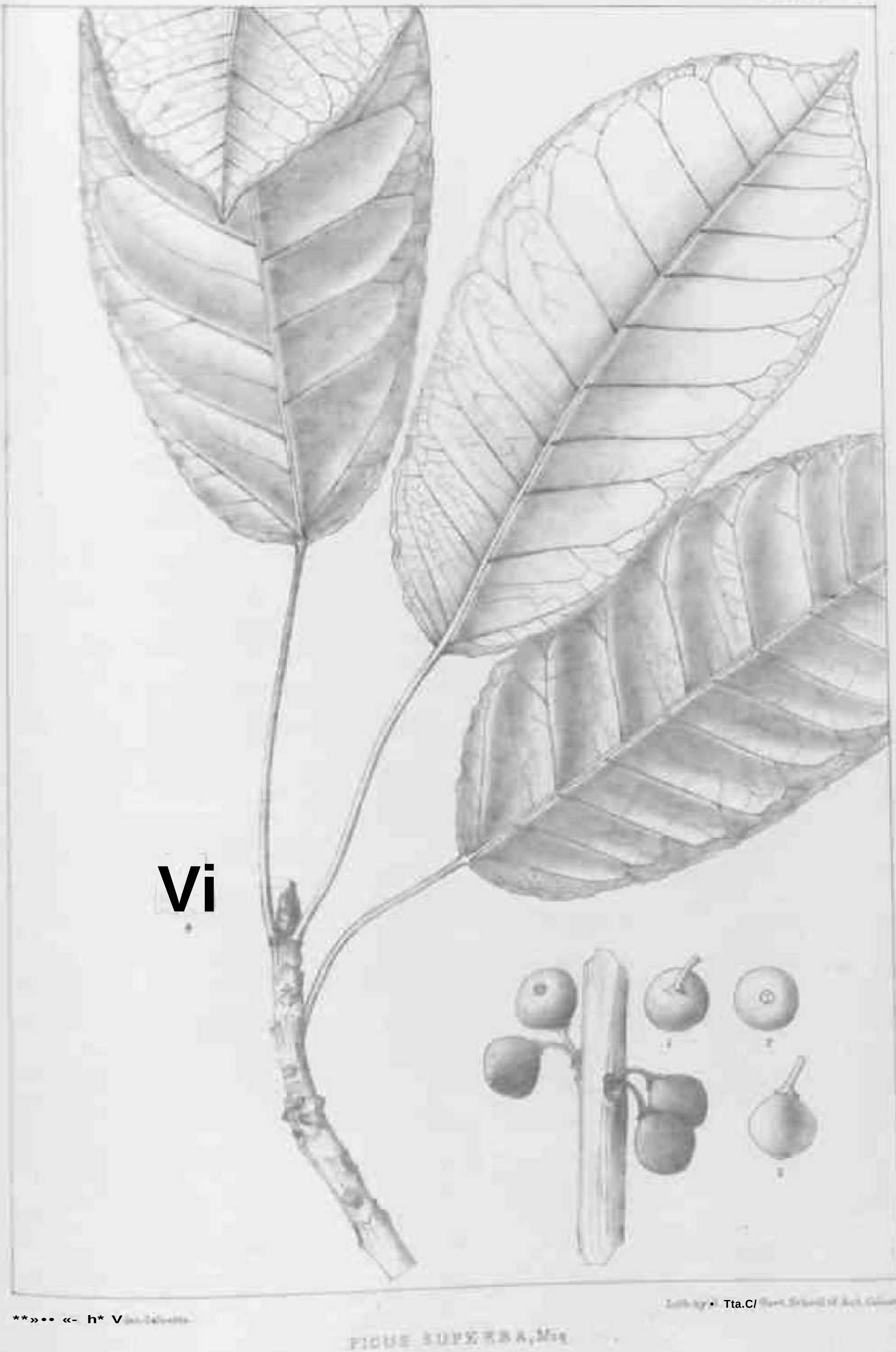
King — King



FICUS TJAKELA, Burm.



FICUS INSIGNIS, Kurz.



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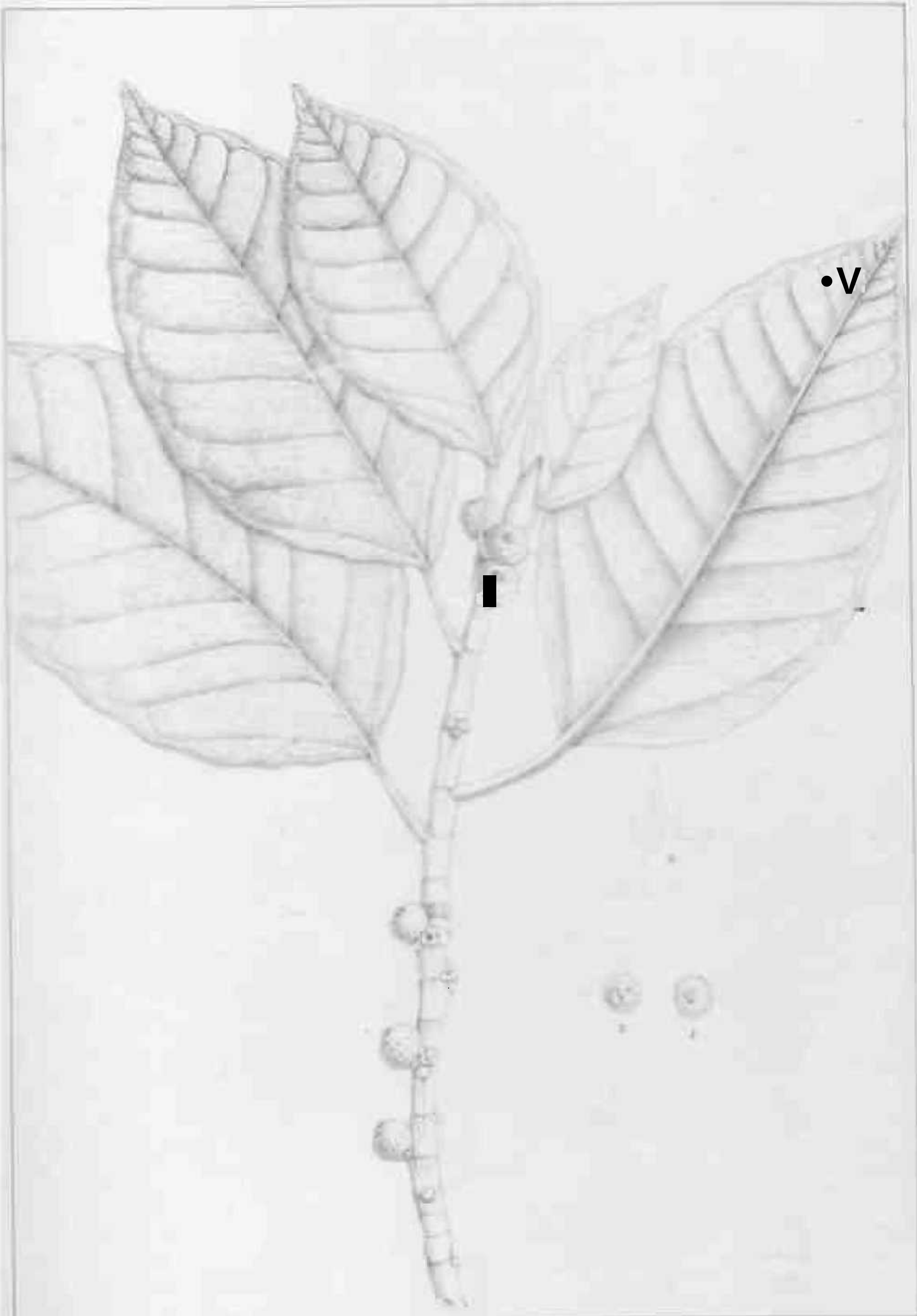
... Calcutta.

FICUS SUPERBA, Miq.

.p4iu

FICUS TSIELA, Roxb.



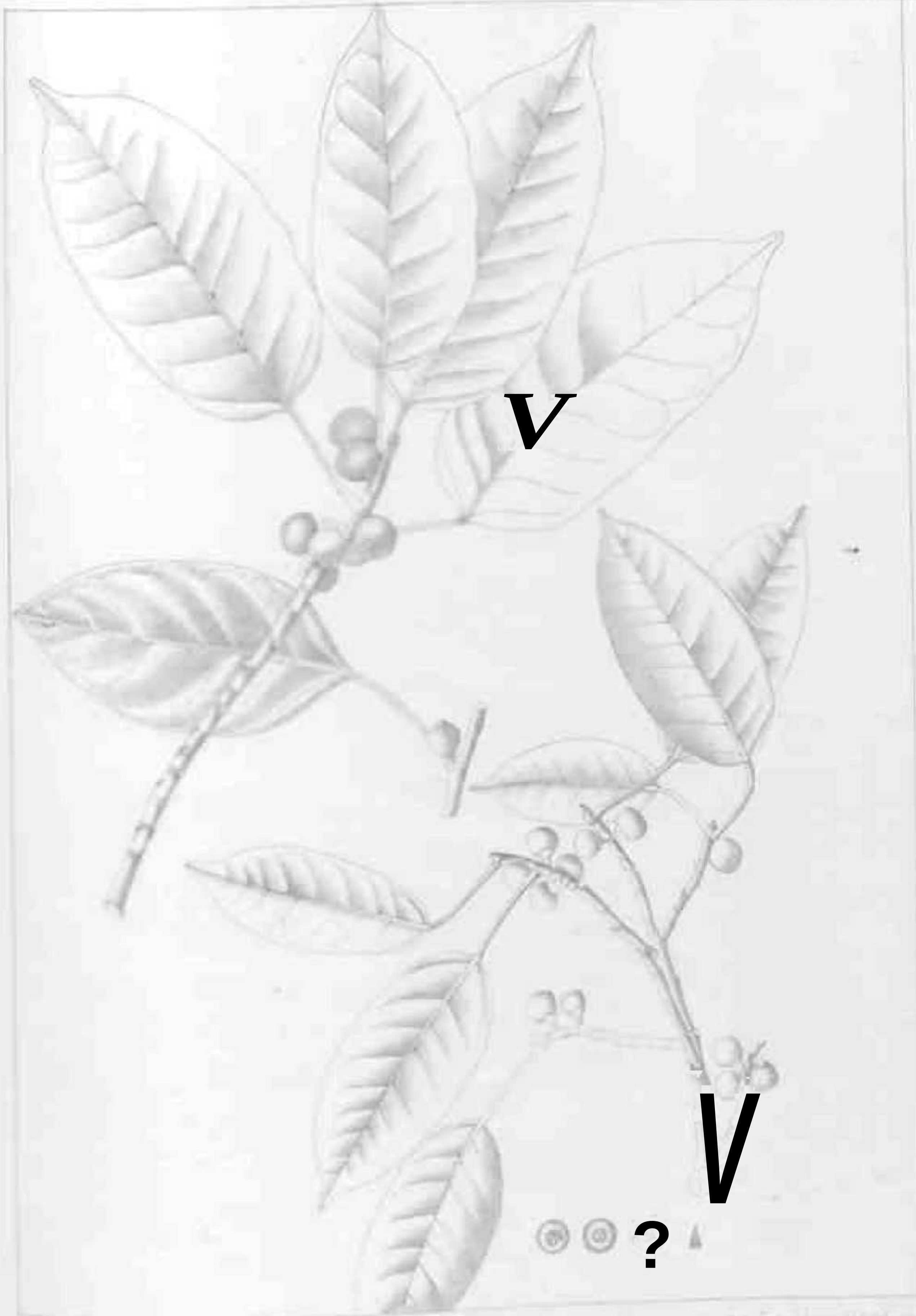
FICUS PSEUDO-TSIELA. Miq.

= FICUS TSIELA. Roxb.

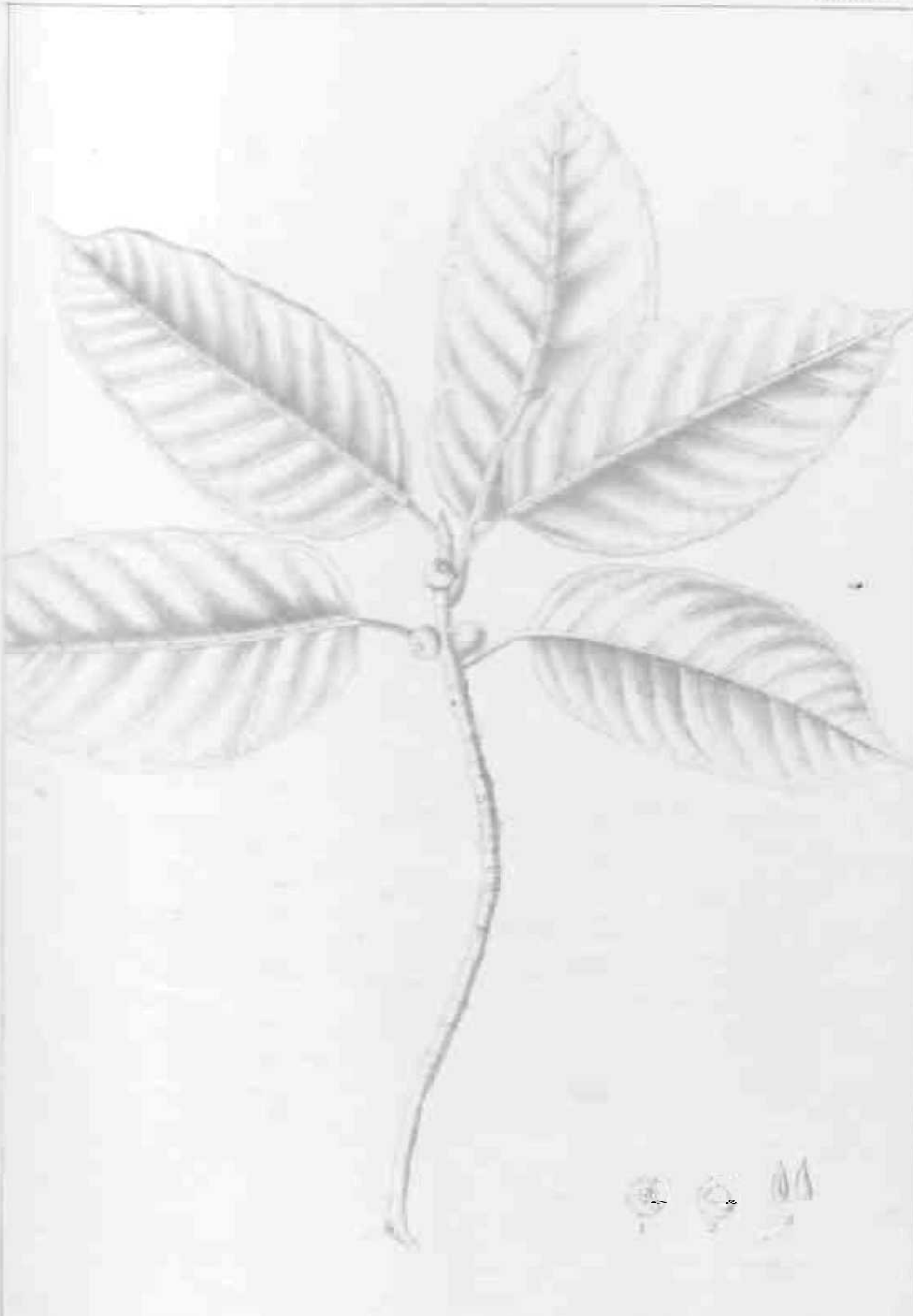
FICUS INFECTORIA, Roxb.

FICUS LAMBERTIANA Miq.

= FICUS INFECTORIA Roxb. var. lambertiana.



FICUS INFECTORIA. Roxb. Var. Wightiana.



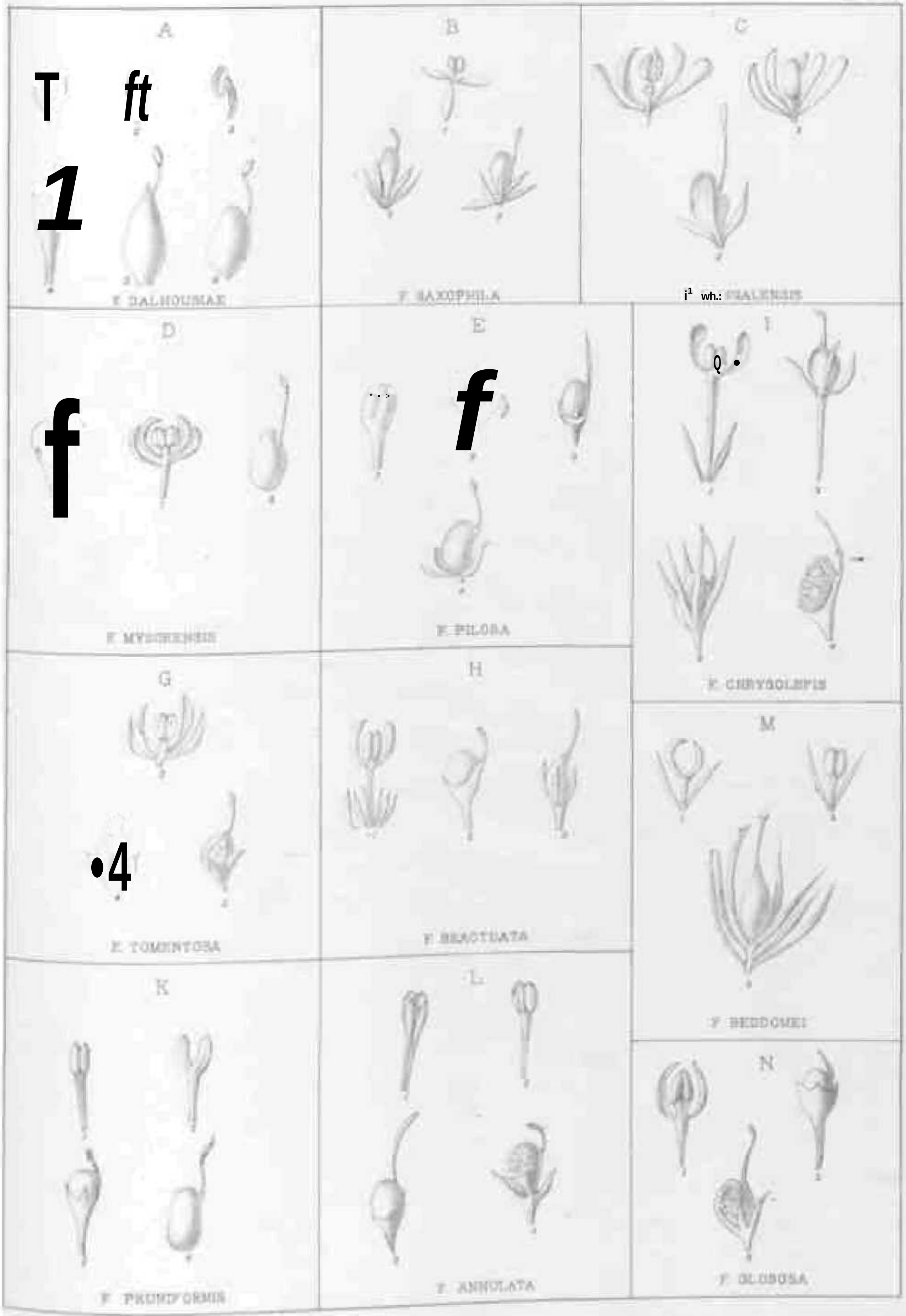
FICUS INFECTORIA, Roxb. VAR FORBESII

PLATE

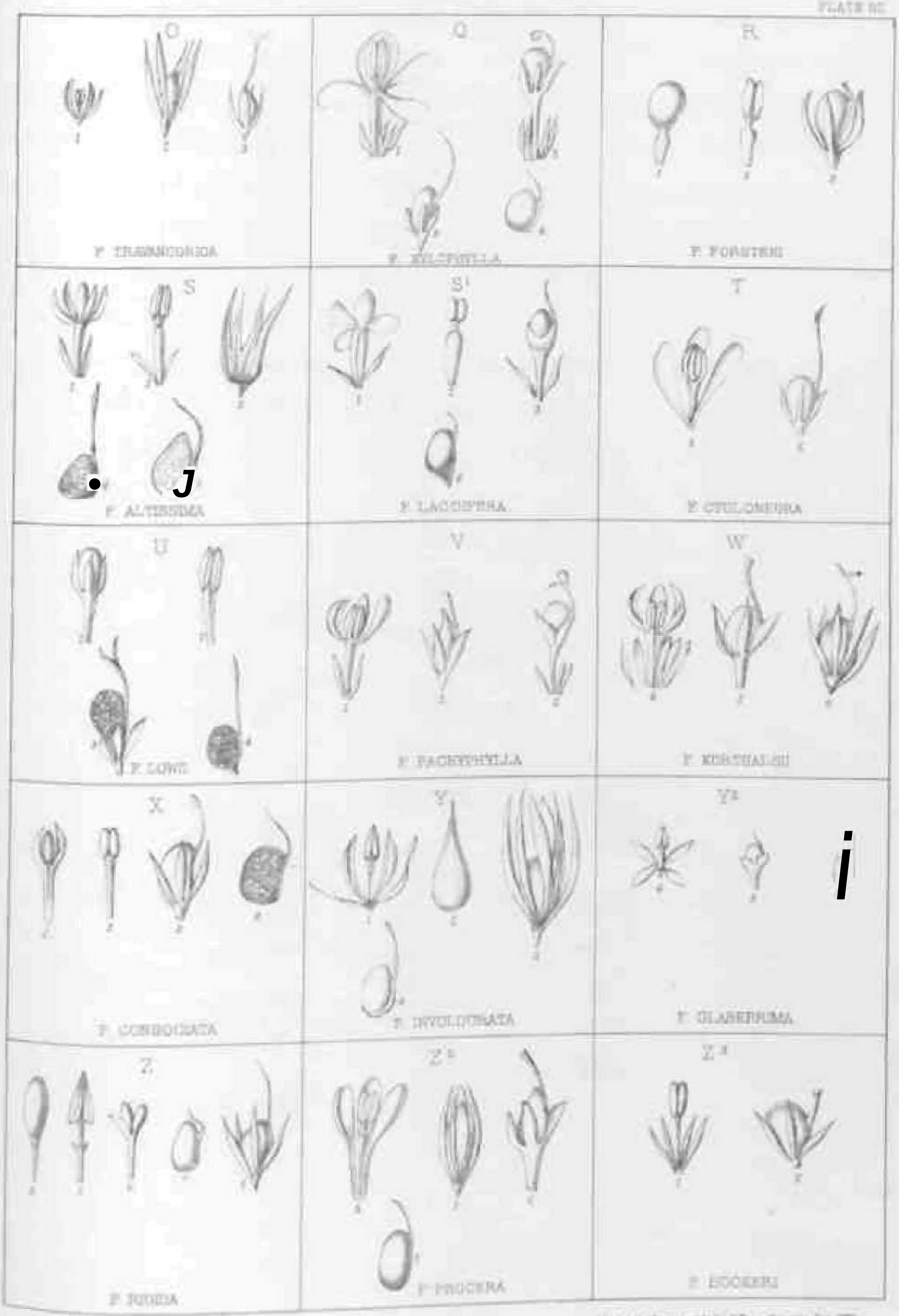
FICUS INFECTORIA Roxb. VAR. CAULOCARPA.

PLATE 83

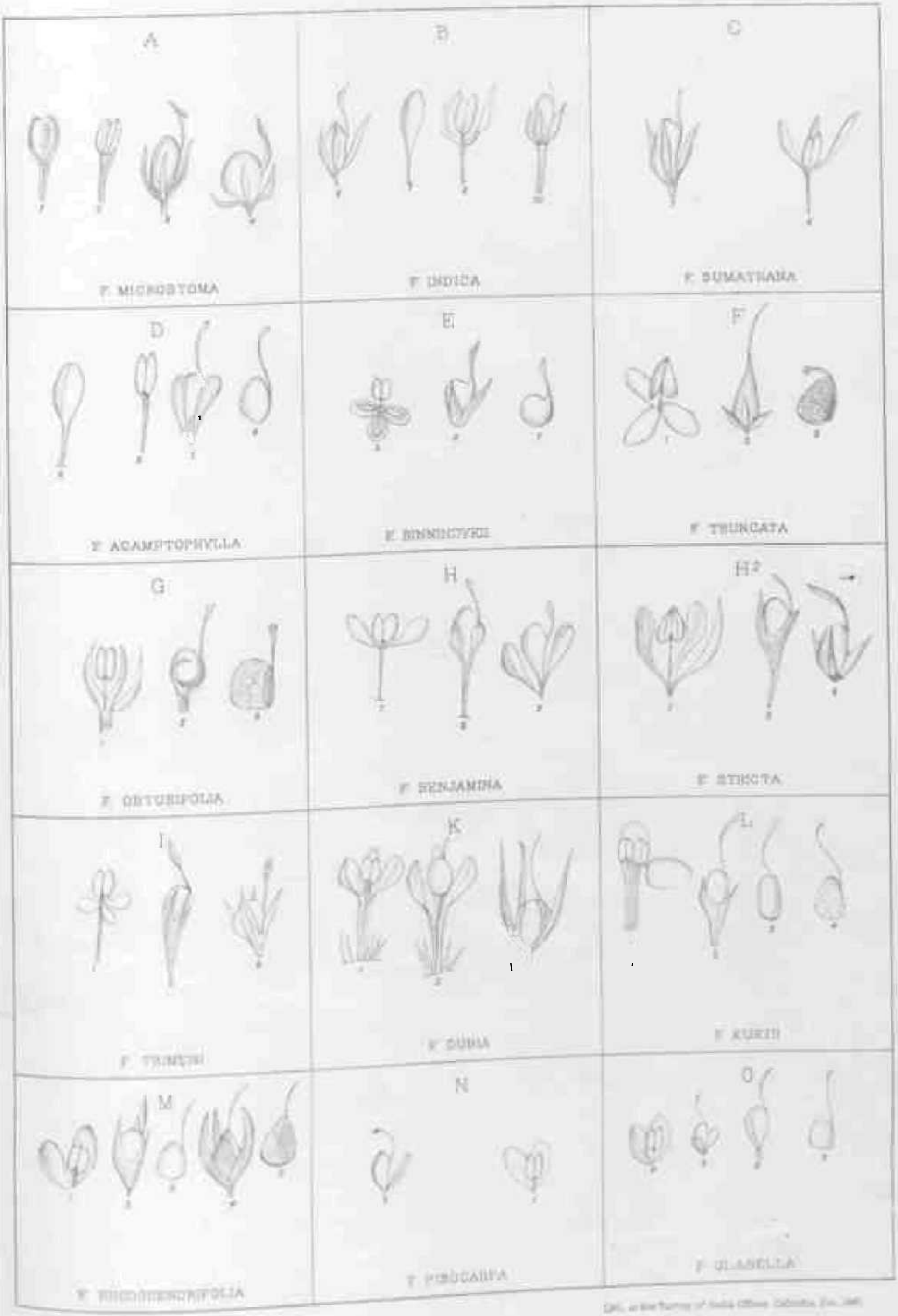
FICUS GENICULATA, Kurz.


A
F. DALHOUSIAE
B
F. SAXOPHILA
C
D
F. MYSORENSIS
E
F. PILOSA
I
F. CHRYSOLEPIS
G
F. TOMENTOSA
H
F. BRACTEATA
M
F. BEDDOMEI
K
F. PRUNIFORMIS
L
F. ANNULATA
N
F. GLOBOSA

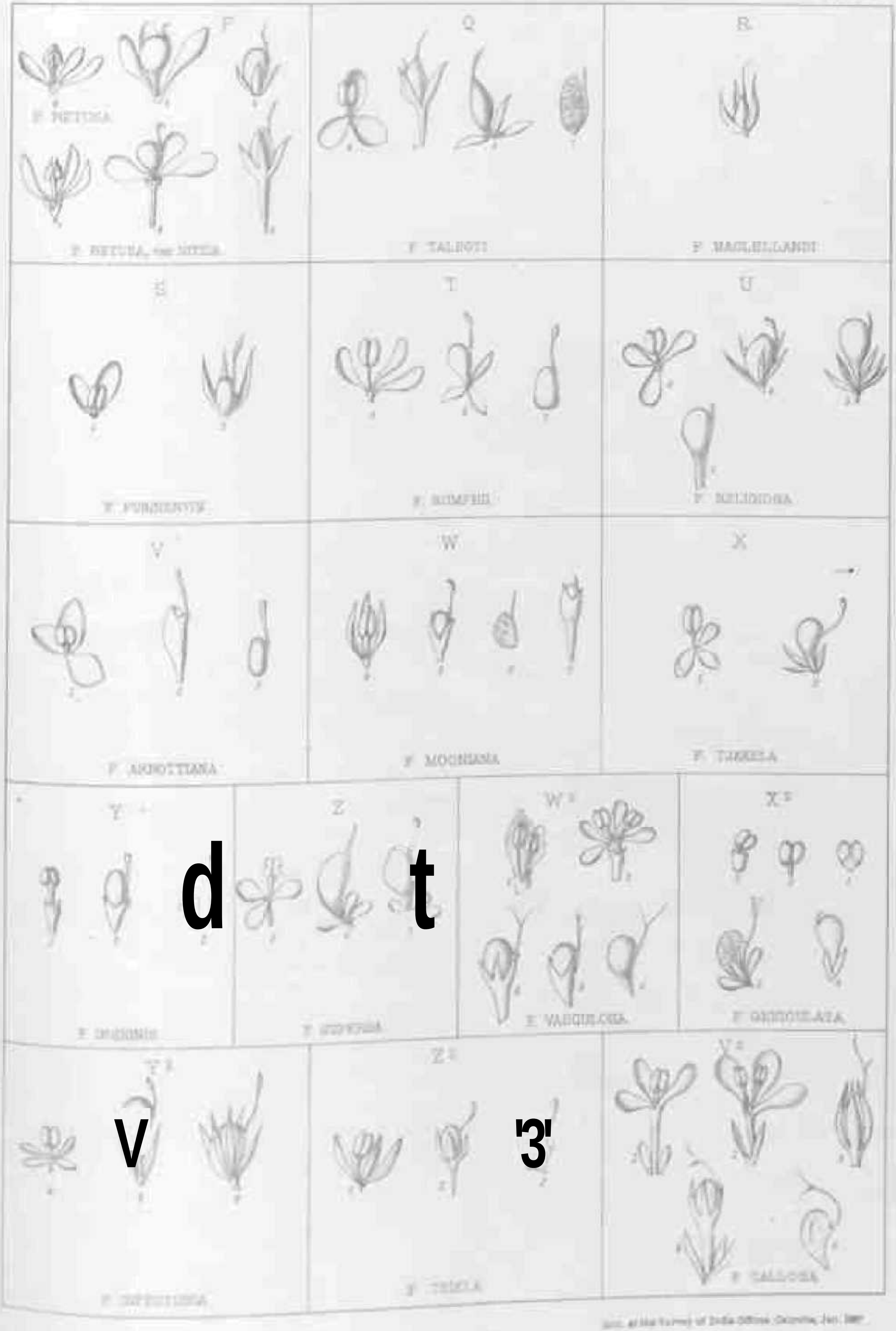
UROSTIGMA



Lith. at the Survey of India Offices, Calcutta


A
F. MICROSTOMA
B
F. INDICA
C
F. SUMATRANA
D
F. ACAMPTOPHYLLA
E
F
F. TRUNCATA
G
F. OBTUSIFOLIA
H
F. BENJAMINA
H²
F. STRICTA
I
K
F. DUBIA
L
M
N
O
F. GLABELLA

UROSTIGMA


F. TALBOTI
F. MACLELLANDI
F. RUMPHII
F. RELIGIOSA
F. ARNOTTIANA
F. MOONIANA
F. VASCULOSA
F. CALLOSA

UROSTIGMA

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FICUS CALLOSA, [redacted] Willd.

PLATE fift

Das del. Hort. Garden Calcutta

Lith. by H. L. Pal, Govt. School of Art, Calcutta

FICUS VASCULOSA, Wall.