THE

TRANSACTIONS

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THE LINNEAN SOCIETY

OF

LONDON.

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SOLD AT THE SOCIETY'S APARTMENTS, BURLINGTON-HOUSE,

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CONTENTS.

PART VI.—JANUARY, 1884.

PART VII.—APRIL, 1884.

PART VIII.—DECEMBER, 1884.

PART IX.—AUGUST, 1886.

PART X.—APRIL, 1887.

PART XI.—SEPTEMBER, 1886.

PART XII.—October, 1886.

PART XIII.—July, 1887.

PART XIV.—July, 1887.

PART XV.—October, 1887.

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December 1881.

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I. *A Revision of the Genus* Vibrissea. *By* WILLIAM PHILLIPS, *F.L.S.*

(Plates I., II.)

Read January 20th, 1881.

THE genus *Vibrissea* was established by the distinguished Swedish mycologist the late E. Fries for the reception of two species of Fungi nearly allied to *Leotium*—viz. *V. truncorum* (Alb. & Schw.) and *V. rimarum*, Fr., chiefly on account of the curious phenomenon presented by these plants of projecting their unusually long slender sporidia with great force from the hymenium, when removed from the water in which they grow and exposed to the dryness of the atmosphere, while many of the sporidia remain attached to the hymenium by their lower extremity, imparting a velvety appearance to its surface. Albertini and Schweinitz * were the first to describe and figure *Vibrissea truncorum* as a *Leotium*; but they are altogether silent on the subject of the projecting sporidia, on which account it must be presumed they had not observed it. From the date of the publication of Fries's 'Systema' (1822) these two species remained the only representatives of the genus till J. A. Weinmann published *Vibrissea vermicularis*, Weinm., in 1836 †. A. C. J. Corda, in his 'Anleitung zum Studium der Mykologie' ‡, in 1842, published *Vibrissea Persoonii*, Corda. The entire description is as follows:—"Köpfchen gewölbt, roth, Stiel grünlich," which is far too imperfect to enable us to distinguish it from *V. truncorum*, the stem of which not unfrequently assumes a greenish shade. In 1852 Dr. Rabenhorst published *Vibrissea flavipes*, Rabh. §, and in the following year *V. pubescens*, Rabh. ‖. In 1857 the MM. Crouan published a species, *Vibrissea Guernisaci*, Crouan, differing altogether in form from those already enumerated by the total absence of a stipes, and simulating the genus *Patellaria* ¶. It was doubted by some whether this should be accepted as a true *Vibrissea*; but, as I have observed specimens collected

* Conspectus Fungorum, p. 297, t. 3. f. 2.

† Weinmann, Hymenom. et Gasterom. p. 487.

‡ Corda, Anleit. p. 97, t. G. f. 66, 3 & 8.

§ Bot. Zeit. 1852, p. 286.

‖ I am unable to find a description of this species.

¶ Ann. des Sc. Nat. vol. vii. p. 173, t. iv. f. 24–26.

by me in Shropshire presenting the characteristic phenomenon of projecting their long sporidia, and giving a velvety appearance to the hymenium, precisely as in the typical species *V. truncorum*, there could be no justification for excluding it from the genus. True it is that a new genus might be established for the reception of this and other sessile species; but a much better course is to modify the definition of the genus so as to comprise both the stipitate and the sessile species, which I propose to do.

Within the last few years the stipitate species have been increased by the following:—*Vibrissea margarita*, White *, *Vibrissea microscopica*, Berk. & Broome †, and *Vibrissea lutea*, Peck ‡. To these I propose to add *Vibrissea pezizoides*, Lib., a species with an excessively short stipes found in the herbarium of the late Madame Libert, a specimen of which was kindly given me by my friend Dr. M. C. Cooke; and *Vibrissea Fergussoni* (Berk. & Broome), placed in the genus *Patellaria* by its distinguished authors, but too nearly allied to the last, as it appears to me, from its internal structure, to admit of its separation. I am aware that it has not hitherto been observed to project its sporidia from the hymenium; but if in all other characters there is a close affinity, I venture to think it should be placed here.

To the *sessile* division, which up to now consists of Crouan's *Vibrissea Guernisaci* only, I propose to add *Vibrissea turbinata*, n. s., found in this country on Ash, and attached to the wood by a much narrower base than the species of MM. Crouan; and *Vibrissea leptospora* (Berk. & Broome), placed originally in the genus *Peziza*.

All the above species of *Vibrissea* grow on decayed wood which has been for some time immersed in water. Unlike the majority of fungi, nearly the whole of, if not all these plants require partial or complete immersion in water for their complete development, for which reason they should be regarded as aquatic fungi. I have gathered some hundreds of specimens of *Vibrissea truncorum* in North Wales, nearly all of which flourished under water; and in the few cases when they occurred above the surface of the water the branches of wood on which they grew were entirely submerged. In like manner *V. Guernisaci* grows either entirely immersed, or in such a position that each individual is thoroughly saturated with moisture.

The wood on which the various species grow is not at all times recognizable, on account of its decayed condition; hence it has not in all cases been specified by authors. *V. truncorum* has been found on Pine wood and Alder, *V. flavipes* on Vine, *V. margarita* on Fir wood, *V. Guernisaci* on Willow, *V. leptospora* on Hazel, and *V. turbinata* on Ash.

It may be necessary to give a brief description of the structure of these plants, for which purpose *V. truncorum* may be selected as presenting the most perfect and therefore typical form.

VIBRISSEA TRUNCORUM.

The Mycelium.—On the surface of the wood, immediately surrounding the spot from which a plant of *V. truncorum* grows, there is seen, on careful examination under the microscope, a layer, more or less dense, of brown, branched, septate, creeping threads, a

* Scottish Naturalist, vol. ii. p. 218.

† Ann. Nat. Hist. 1876, vol. xvii. p. 142, no. 1618.

‡ XXV. Report N.Y. Mus. p. 97, t. i. f. 19–23.

kind of thin subiculum, not much unlike what is found under *Peziza fusca* (Pl. I. fig. 1). This is the mycelium. Repeated examinations of the tissue of the wood failed to show that this mycelium had penetrated to any depth; it rather lay upon the surface, or at most only entered into the disintegrated portion. The wood immediately beneath was perfectly firm and uninjured. The mycelial threads are about ·005 millim. in diameter. *Vibrissea Guernisaci* has a mycelium in all respects similar to the above, though not so abundant.

The Stipes.—The first indication of a young plant of *Vibrissea truncorum* is the formation, by the mycelium, of a minute conical protuberance just visible by the aid of a pocket lens. If one of these be examined by making a vertical section when about half a millimetre high, it will be seen to consist of two distinct tissues—the one external, the other internal. The external tissue (cortical tissue) is composed of a thin compacted stratum of blackish threads, running nearly parallel to each other, of the same size as those of the mycelium, and in all respects similar to them. Within this is a pale nucleus (the internal tissue, medullary tissue), composed of nearly colourless parallel threads of a less diameter than those forming the exterior tissue. When viewed in mass this medullary tissue is of a pale cinereous colour. In this early stage of an individual plant we see present the two tissues which form the stipes of the mature plant, whether it be long or short. In the sessile species they are equally present.

The stem of *V. truncorum* varies from 2 to 6 lines long, and is barely a line thick, often enlarged at the top; the texture is tough; and the colour is pale glaucous in the upper part, darker below; and it is minutely squamulose. The squamulæ are produced by the cells of the cortical tissue projecting from the surface as dark septate short hairs. In *Vibrissea margarita*, White, these hairs are more conspicuous and prominent, extending up the whole of the stipes even to the margin of the receptacle, which gives this species its distinguishing character. In old specimens the stipes of both becomes partially hollow.

The Hymenium.—When a plant of *Vibrissea truncorum* is approaching its maturity the hitherto cylindrical stem begins to enlarge at the summit, and the cortical tissue opens at a point in the centre, through which the paler medullary tissue may be seen forcing its way to the light, preparing to give rise to the hymenium. The hymenium owes its origin to the medullary tissue by the formation of a thin subhymenial tissue, somewhat closer and more compact, from which the asci and paraphyses immediately arise. In the earliest stage of its existence the hymenium consists of a bed of upright, closely adjacent, slender threads, destined to become the asci and paraphyses. It is impossible at this stage to say which of these threads will be asci and which paraphyses; for they are in all points alike. They are elongated cells filled with a transparent protoplasm in the form of minute granules. The first differentiation that can be observed in these threads is that some of them throw out lateral branches, which proves they are paraphyses; for the asci are never branched. At a more advanced stage others of these threads increase in diameter from the summit to near their base, and the protoplasm they contain arranges itself in parallel lines, but having a waved appearance: these are the asci. On further approaching maturity this waved appearance disappears, and the protoplasm resolves itself into a bundle of eight straight slender transparent threads, occupying the whole interior of the mother cell—the ascus. A perfect ascus measures ·25 millim. long and ·005 millim. broad.

The sporidia, when mature, are long slender filiform bodies, tapering at the extremities, the protoplasm they contain being at first arranged in irregularly-sized globules, but ultimately, expanding, give the appearance of cells divided by walls at nearly equal intervals throughout their entire length. In comparison with those of other Discomycetes, the sporidia are very long.

The paraphyses which form the greater part of the hymenial layer are long slender filaments rising above the asci, having enlarged club-shaped apices filled with the colouring-matter that gives the characteristic colour to the hymenium. They are once, twice, or thrice branched from near the top, and are divided by septa at remote intervals.

Having given a brief description of the structure of the several parts of *Vibrissea truncorum*, it is necessary to offer an explanation of the phenomenon which was the main ground with Fries for establishing the genus—namely the violent ejection of the sporidia when subjected to a change in the hygrometrical state of the atmosphere, and the consequent velvety appearance assumed by the hymenium, owing to many of the sporidia remaining attached by their lower extremities to the surface of the hymenium. It is a well-known fact that the habit of shooting forth the sporidia from the asci with considerable force is more or less common throughout the whole of the Discomycetes; while in the genus *Ascobolus* the asci themselves become separated from the subhymenial tissue, and are forced upwards above the general level of the hymenium. The mutual pressure produced in a bed of closely set paraphyses and asci, the whole possessing a great capacity for the absorption of moisture, by which the entire mass is made to occupy a space exceeding the capacity of the receptacle, will account in *Peziza* for the more mature asci (the walls of which have become thin by expansion) bursting at the point of least resistance, which is the summit, thus allowing their contents to be ejected. In the genus *Vibrissea*, however, this mode of accounting for the ejection of the sporidia will not apply; for the phenomenon does not take place on expansion of the hymenium by absorption of moisture, but on contraction produced by drying. The normal condition of the hymenium of *Vibrissea* is complete saturation, owing to the plants growing in water; and the shooting forth of the sporidia is not witnessed till they are taken out of the water and exposed to the atmosphere. We are compelled, therefore, to seek some other explanation. I submit the following.

The greatly distended hymenium in a mature plant assumes a highly convex form, being forced considerably above the margin of the receptacle, in many cases bending over the margin, so as to become concave beneath, the subhymenial tissue necessarily taking a convex form, while the medullary tissue of the stem is extended lengthwise to its utmost capacity. The cortical tissue is less affected by moisture and more rigid in texture. This being the condition of things when a plant is removed from water and exposed to the drying influence of the atmosphere, evaporation at once takes place, when the medullary tissue contracts in length, draws down the subhymenial tissue, together with the hymenium, into the already too narrow receptacle, thus causing violent lateral pressure throughout the whole of the hymenium. So far from the cortical tissue expanding to accommodate this extra demand for space, it also undergoes a degree of contraction, contributing still more to the lateral pressure existing in the hymenium. This pressure would produce very little effect upon the sporidia if a process had not previously been going on at the summits of the asci tending to facilitate their exit. In immature asci the walls of the summit are thicker than the sides; but on maturing, the summits become the thinnest, and most easy of fracture, as can easily be proved by pressing them under a microscopic slide. Here, then, relief to the violent lateral pressure set up in the hymenium, as explained above, is found; and the slender sporidia, narrowed towards each extremity, are forced upwards, through the attenuated walls of the asci at the summits, into the air. The fracture through which they escape takes no definite form, like the operculum in *Ascolobus*, *Peziza*, &c., but is a mere irregular rent. Fries says that he has observed a strongly alliaceous odour given out by *Vibrissea truncorum* during the time it is exhibiting the singular phenomenon we have been describing; but I have not been able to distinguish it when collecting my specimens in North Wales.

VIBRISSEA, Fries, amended.

Aquatic fungi (except *V. rimarum*), bearing the exposed hymenium on a plane or cup-shaped membranaceous receptacle, stipitate or sessile, fleshy in texture, firm, ejecting from the asci slender elongated sporidia, which often remain attached by their extremities to the surface of the hymenium, giving it a velvety appearance.

Hab. On decayed wood submerged in water.

I. *Stipitate.*

1. VIBRISSEA TRUNCORUM (Alb. & Schw.), Fr. Sys. Myc. vol. ii. p. 31; Sum. Veg. p. 360. *Leotia truncorum*, Alb. & Schw. Consp. Fung. p. 297, t. 3. f. 2; Schwein. Fung. Carol. p. 88; Pers. Mycol. Eur. p. 199. *Leotia clavus*, id. *op. cit.* p. 200, t. xi. f. 9. *Vibrissea truncorum*, Wall. Flo. Ger. vol. iv. p. 548; Kromb. i. p. 76, t. v. f. 34–36; Corda, Anl. t. G. f. 66, 1, 2: Bail. t. 21; Bisch. Krypt. fig. 3374; Nees von Esen. u. Hen. Sys. der Pilzen, vol. ii. p. 67, t. 21; Rabh. Krypt. Flo. i. p. 339; Berk. Eng. Flo. vol. v. p. 186; Crypt. Bot. p. 284, fig. 328; Out. p. 361; Karst. Myco. Fenn. p. 26; Cooke, Handb. p. 662, fig. 328; Stev. Myco. Scot. p. 298; Quellet, Champ. p. 379; Peck, xxv. Report N.Y. Mus. p. 98.

Exsiccati: Moug. & Nest. no. 781; Phill. El. Brit. no. 4.

Fasciculate, gregarious or scattered; hymenium convex, golden yellow or blood-red, forming with the membranaceous receptacle an orbicular head; stipes terete, glaucous, squamulose; asci cylindrical; sporidia 8, filiform, multiseptate; paraphyses very slender, branched, slightly enlarged at the summits.

The head is about 2 lines across, at first plane, becoming convex, often slightly repand, umbilicate beneath; the stem at first stuffed, becoming hollow, 2 to 6 lines high, bluish grey, with blackish squamules or smooth, darker towards the base; the asci are very long, cylindrical, numerous; the sporidia very slender, eight in each ascus, divided by numerous septa ·25 millim. long, ·001 millim. broad, narrower towards the extremities, paraphyses numerous, branched, very slender, septate, enlarged a little at the summits, which are slightly coloured. When removed from the water, and exposed for a short time to the air, the sporidia shoot out from the hymenium with more or less violence, many of them remaining attached by one extremity to the hymenium, waving to and fro like floss silk, glistening in the light.

On decayed wood (Alder, Birch, Pine, &c.) in subalpine streams. Rare. Capel Curig, North Wales; Scotland; South of France; United States of America.

2. VIBRISSEA MARGARITA, White. Scott. Nat. vol. ii. p. 218; Berk. & Broome, Ann. Nat. Hist. 1875, vol. xv. p. 37, no. 1477; Stev. Myco. Scott. p. 298; Grevillea, vol. ii. p. 162.

Simple; head orbicular, orange-vermilion, margin hispid; stem cylindrical, hirsute with black articulated hairs, internally whitish cinereous.

On dead sticks of heather in a pool of water on Mòr Shròn, Braemar, at an altitude of 2200 feet. September and October 1873.

"The stems are simple, varying from 2 lines to ½ an inch in height, springing from complicated threads, and covered with black-jointed hairs or fibres; at the junction with the head the stem is less hairy and paler in colour; internally it is solid and greyish-white. The head is flattened orbicular (sometimes concave in the middle), and of a beautiful orange-vermilion in colour; the margin has a fringe of close appressed hairs of the same character as those on the stem; underneath the head is paler in colour at the junction with the stem. The species is readily distinguished from its ally, *V. truncorum*, by the hairy stems and differently coloured heads."—*Dr. Buchanan White*.

3. VIBRISSEA RIMARUM, Fr. Sys. Myco. ii. p. 32.

Subfasciculate, yellowish, capitulum becoming tawny, stem compressed.

Allied to *V. truncorum*, but really different. Substance dry but fleshy. The whole fungus, from the peculiar station, greatly compressed; stem 1 inch long, of variable thickness, flexuose, subconnate at the base; capitulum hemispherical, comparatively small, darker, at length rufous; but the whole fungus yellow.

On chinks of beams and other old wood used in the building of domestic houses. Kamtschatka, *Fries, l. c.*

Assuming that specimens of this species exist in the herbarium of the illustrious Fries, it would be highly interesting to submit them to a careful microscopical analysis to determine the structural differences between it and its allies. There is so wide a difference in the conditions of growth that one is tempted to doubt this being a true *Vibrissea*, nothing being said to indicate its aquatic habit. I have included it, however, although it does not accord with my definition of the genus, leaving it open for future investigation.

4. VIBRISSEA VERMICULARIS, Weinm. Hymenom. et Gast. p. 487; Enum. Petro. p. 246.

Simple; capitulum suborbicular, sublacunose, watery pallid; stipes somewhat terete, fusco-nigrescent.

Gregarious, stipes closely adherent, the younger filled with a gelatinous mass, the older subfistulose, for the most part cylindrical (very rarely attenuated or compressed towards the base), straight or curved, tough, smoky-black, paler below the pileus. Pileus $\frac{1}{2}$–2″ broad, the younger ones watery-pallid, then very dilutely cærulescent.—*Weinm.*

On decayed moist wood of *Alnus incanus.* May.—*Weinm.*

This differs from *V. truncorum* in the colour of the hymenium and in being sub-lacunose; it is probably only a form of that species.

5. Vibrissea flavipes, Rabh. Bot. Zeit. 1852, p. 286.
Exsiccati: Klotz. Herb. Myco. cent. xvii. no. 27 (1627).

Gregarious and subcæspitose or scattered, simple, rooting in the matrix; stem 1–3‴ long, erect or curved, terete, yellow, often pulveraceous; receptacle from greenish becoming glauco-cinerascent, floccose with the erumpent sporidia.

On *Vitis vinifera.*—*Rabh.*

Not having seen specimens of this species, I simply reproduce the description of Dr. Rabenhorst.

6. Vibrissea lutea, Peck, xxv. Report N.Y. Mus. p. 97, t. i. f. 19–23.

Head subglobose; hymenium smooth, yellow, margin slightly lobed, deflexed, free; stem equal, solid, yellow, but more highly coloured than the hymenium; asci clavate or cylindrical; sporidia long, filiform. 6–12″ high; head 2–3″ in diameter.

On prostrate mossy trunks of trees, and amongst fallen leaves in woods. North Elba, U. S. August.

I have not seen a specimen of this species, which appears to differ from the preceding in the colour of the hymenium.

7. Vibrissea Fergussoni (Berk. & Broome). *Patellaria Fergussoni*, Berk. & Broome; Ann. Nat. Hist. 1875, vol. xv. p. 39, no. 1490, t. ii. fig. 6.

Stipes short, thickened upwards; cups plane, externally dark brown, granulose; hymenium plane or pulvinate, yellow; asci elongated; sporidia filiform; summits of the paraphyses globose.

On *Prunus Padus*, New Pitsligo, Rev. J. Fergusson.—*Berk. & Broome.*

The clear description, together with the excellent figures given by Messrs. Berkeley & Broome in the Ann. Nat. Hist., leave no doubt on my mind that this is a good species of *Vibrissea.*

8. Vibrissea microscopica, Berk. & Broome, Ann. Nat. Hist. 1876, vol. xvii. p. 142. no. 1618; Grevillea, v. p. 59.

Very minute, plane or cup-shaped; hymenium and receptacle grey; stipes short, slender, black; asci clavate; sporidia eight, filiform; paraphyses filiform, numerous.

On damp fir wood, Rannoch.—*Dr. Buchanan White.*

Scarcely visible without a lens. Stem very short, black; head grey, leaving a cup-shaped depression when completely washed off; sporidia ejected, filiform.—*Berk. & Broome.*

The receptacle ·2 millim. across, the whole plant ·2 millim. high, sporidia ·05–·06 × ·002 millim.

The drawing is made from the unique specimen in the herbarium of the Rev. M. J. Berkeley, presented by him to the Royal Herbarium, Kew. By the kindness of Sir Joseph Hooker I was permitted to examine the specimen.

II. *Sessile.*

9. VIBRISSEA GUERNISACI, Crouan. Ann. des Sc. Nat. 1857, t. iv. f. F. 24–26; Flo. Fin. p. 46; Phill. & Plow. Grevillea, iv. p. 120.

Exsiccati: Phill. El. Brit. no. 143.

Minute, lentiform or turbinate, between fleshy and gelatinous; hymenium pallid, ochraceous or grey, convex; asci cylindrical, long; sporidia 8, filiform, hyaline; paraphyses slender, branched near the clavate summits.

On dead submerged branches of *Salix* in water. May and June. Rare. France, Britain. Named after Viscount Guernisac. Plants 1–3 millim. in diameter; sporidia ·27 millim. long.

At first it appears on the branches as a small greyish wart with a somewhat paler point in the centre. In a more advanced state it assumes the form of a thick disk, similar to the apothecia of *Lecanora.* The hymenium is convex, soft in texture, pallid bluish-yellow, margined by the receptacle, which is submembranaceous, and in section cup-shaped, bluish-black, adhering by the greater part of its base to the wood. The asci are very long and cylindrical, not as figured by M. Crouan in Ann. des Sc. (*l. c.*). The paraphyses are septate, often branched, and clavate at the summits. The sporidia are ·27 millim. long, very slender, and when mature septate. This species presents the same phenomenon of projecting the sporidia from the asci as exhibited by *V. truncorum.*

10. VIBRISSEA PEZIZOIDES, Lib.

Gregarious or scattered, sessile or with a very short stout stipes, disciform, concave beneath; hymenium yellow, convex, umbilicate, margin reflexed, incurved beneath; asci cylindrical; sporidia 8, filiform; paraphyses slender, branched near the summits, which are slightly enlarged.

On dead wood. Plants 1–2 millim. across. Sporidia ·23 × ·002 millim.

I am indebted to Dr. Cooke for a specimen of this interesting species, which he derived from the herbarium of the late Madame Libert.

11. VIBRISSEA TURBINATA, n. s. *Helotium vibrissioides*, Pk. in MS.

Scattered, turbinate; hymenium plane or convex, ochraceous yellow, margined by the thin edge of the receptacle, which is bluish-grey, smooth; asci cylindrical; sporidia long, filiform; paraphyses slender, branched near the summit, which is slightly enlarged and brownish.

On branches of Ash, in watercourse. Shrewsbury, 1876. Plants ½–1 millim. across; sporidia from 1·35–2 millim. long.

12. VIBRISSEA LEPTOSPORA (Berk. & Broome). *Peziza leptospora*, Ann. Nat. Hist. 1866, vol. xviii. p. 126, no. 1166, t. iv. f. 30. *Vibrissea coronata*, Phillips in herb.

Hemispherical, then expanded, sessile; hymenium pallid or straw-coloured, externally lurid from the scattered black adpressed flocci, margin crenulate; sporidia filiform.

On decayed wood, Jedburgh. Plants 2–3 millim. across; sporidia 2·3 millim. long, ·032 millim. thick.

"About half a line across; at first perfectly globose, often collapsed in the centre, but gradually opening and exposing the soft, pallid, sometimes straw-coloured hymenium; asci oblong; sporidia very long and slender, filiform, flexuous, with a row of globose nuclei, at length repeatedly septate."—*Berk. & Broome, l. c.*

I venture to regard this as more closely allied to the sessile *Vibrisseæ* than to *Peziza*. I found a plant on hazel twigs near Shrewsbury, which at the time appeared to be an undescribed *Vibrissea*, to which I appended the name *V. coronata*. On looking over the Discomycetes of Mr. Berkeley's splendid herbarium at Sibbertoft, I was struck by the striking resemblance of my *V. coronata* to his *Peziza leptospora*, which a more careful analysis has proved to be identical.

Rejected Species.

VIBRISSEA PERSOONII, Corda, Anleit. p. 97, t. G. f. 66. 3 & 8.

"Köpfchen gewölbt, roth; Stiel grünlich.

"An faulenden Baumstöcken sie sitzen."—*Corda.*

The only character by which this is distinguished from *V. truncorum* is the greenish stem; but as *V. truncorum* often possesses a greenish shade in the stem, there remains no difference on which we can depend.

VIBRISSEA PUBESCENS, Rabh.

I have not been able to discover any description of this species.

DESCRIPTION OF THE PLATES.

PLATE I.

Fig. 1. *Vibrissea truncorum*, natural size.

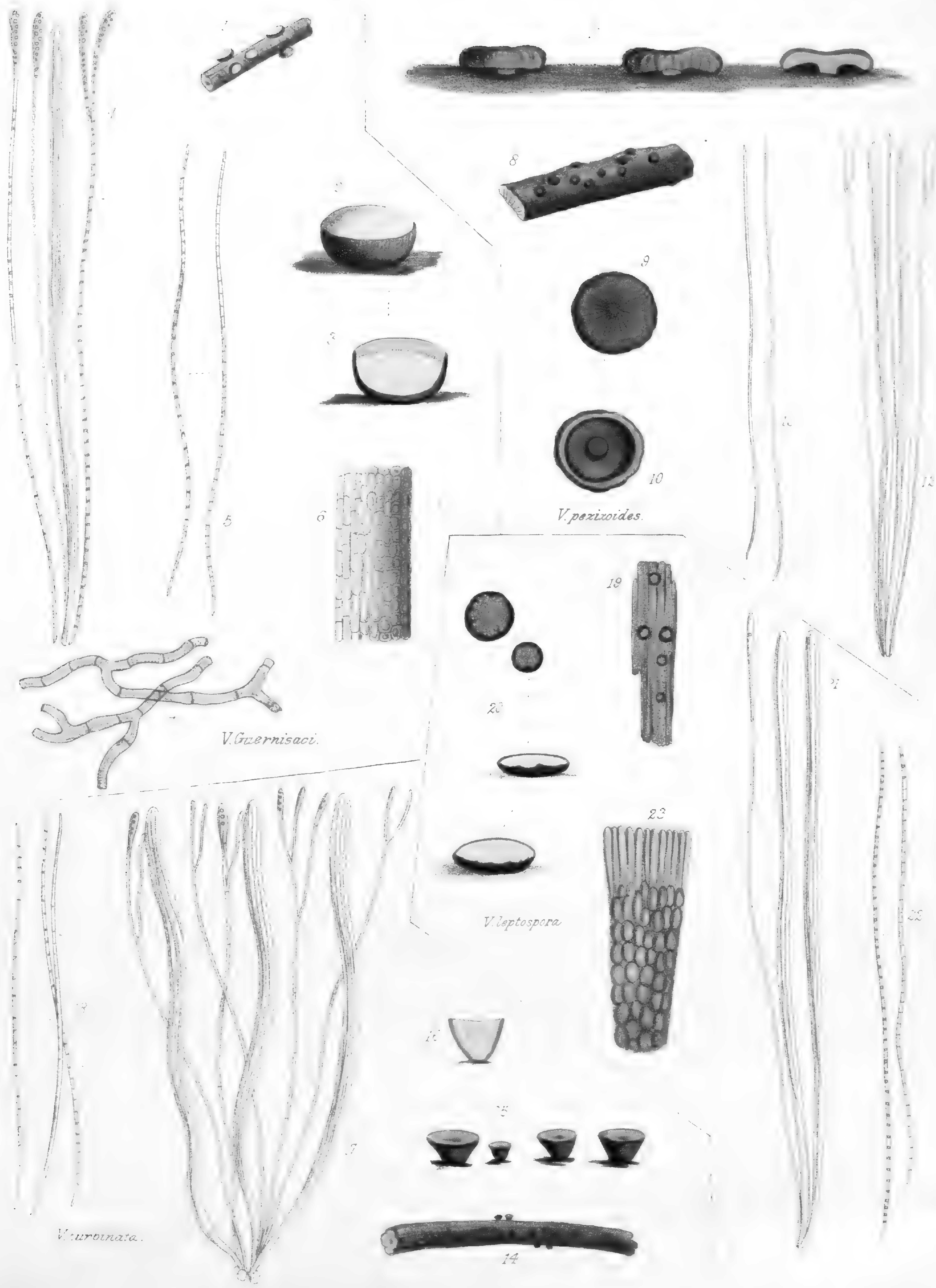
2. A plant magnified five times.
3. A perpendicular section of the same.
4. An ascus and three paraphyses, showing the mode of branching in the latter.
5. An ascus with the upper part torn off, exposing the sporidia.
6. Two mature sporidia.
7. A group of threads of the mycelium coloured as they appear by transmitted light under the microscope.
8. A section of the stipes near the base, showing the cortical tissue. Figures 4–8 magnified nearly 400 times.
9. A section of a young plant in its earliest stage, showing the two tissues of which the stipes is composed.

Fig. 10. Three plants of *Vibrissea margarita*, White, the natural size.
11. A plant magnified five times.
12. A perpendicular section of the same.
13. An ascus and three paraphyses, showing the mode of branching in the latter.
14. An ascus with a part removed, to show the sporidia.
15. Sporidia.
16. A portion of the cortical tissue showing the hairs on the stem. Figures 13–16 magnified nearly 400 times.
17. *Vibrissea microscopica*, natural size.
18. Plants magnified 50 times.
19. Plants magnified 100 times.
20. A section, magnified 100 times.
21. Cup and sporidia as represented on original specimen by Messrs. Berkeley and Broome.
22. A group of asci and paraphyses, magnified nearly 400 times.
23. Three sporidia, magnified same as last.
24. A portion of the tissue of the receptacle, magnified to the same extent.

Plate II.

Fig. 1. A group of *Vibrissea Guernisaci*, natural size.
2. A plant magnified five times.
3. A section of the same.
4. An ascus and the paraphyses, magnified nearly 400 times.
5. Two sporidia, magnified the same.
6. A section of the cortical tissue, magnified the same.
7. A portion of the mycelial threads, magnified the same.
8. *Vibrissea pezizoides*, Lib., natural size.
9. An individual magnified ten times, showing the upperside.
10. Another, showing the underside.
11. Two—one showing the side view, and one a transverse section through the centre.
12. A group of asci and paraphyses, magnified nearly 400 times.
13. Two sporidia, magnified to the same extent.
14. *Vibrissea turbinata*, natural size.
15. Four individuals, magnified ten times.
16. A perpendicular section through the centre, magnified ten times.
17. A group of asci and paraphyses.
18. Three sporidia removed from the ascus.
19. *Vibrissea leptospora*, the natural size.
20. A group of individuals magnified five times.
21. Asci and paraphyses, magnified to about 400 times.
22. Sporidia, magnified to the same degree.
23. A fragment of the receptacle, showing structure of tissue.

J.N. Fitch lith



SPECIES OF VIBRISSEA.

II. *On Central-African Plants collected by Major* Serpa Pinto. *By* Prof. Count Ficalho (*Lisbon*) *and* W. P. Hiern, *M.A.*, *F.L.S.*

(Plates III.–VI.)

Read June 16th, 1881.

THE specimens herein discussed were collected by Major Serpa Pinto in the month of August of the year 1878, along the upper course of the river Ninda, an affluent of the Zambesi, on the west side of the high plateau. As regards the climate of this locality, the temperature is described as variable, the weather as very dry during seven or eight months of the year, and very wet during two or three months. The nature of the soil is metamorphic argillaceous schist; the latitude is 14° 46′ south, the longitude 20° 56′ east of Greenwich; the elevation is 1143 metres above the ocean.

The readings of the thermometer at 6 o'clock on the mornings of August 11, 12, and 13, in the year 1878, were respectively $43\frac{1}{2}$°, 41°, and 40° F. During the same days the wind blew strongly from the east, and the sky was clear.

In consequence of the extreme smallness of the quantity of paper in the possession of Major Serpa Pinto, all he did with regard to botanical collections was to convey a few plants from this particular point of his journey. This part of Africa is fertile and salubrious, though destitute of population; and it was the first stage of the journey in which elephants were met with. He speaks of it as follows ('How I crossed Africa,' vol. i. p. 357, English edition, 1881):—"On the following day [10th August 1878] we penetrated into an extensive thorny forest, through which we had literally to cut our road. After a fatiguing march of five hours, the most difficult and painful I had yet had in the country, we pitched our camp at the source of the river Ninda, having left a great part of our wearing apparel on the brambles by the wayside. .... I had then at length reached the birthplace of that [p. 358] Ninda which was so renowned for the ferocity of the denizens of its banks. The lions which favoured it had not yet succeeded in devouring me; but I could not help thinking [that] if they wished to do so they must make haste about it, or they would find only the miserable remnants left by thousands of insects who considered me fair prey.... [p. 361] The river Ninda runs through a plain slightly rising to the eastward, and which I was assured extends southward all the way to the junction of the Cuando and Zambesi. Up to the point where I was encamped the forest descended thickly to the very brink of the river; but from that spot onwards there are merely groups of trees, scattered here and there over the enormous plain."

This part of the world is included in the eighth botanical region of Grisebach ('Die Vegetation der Erde,' 1872), which he designates Tropical Africa and Natal; and it would properly be considered to belong to the south-central district of Tropical Africa, in the sense used by Professor Oliver in his 'Flora of Tropical Africa.' It is, however, not very far from the northern boundary of the ninth botanical region of Grisebach, which he calls the Kalahari region. No collections from this locality have been previously made and forwarded to Europe to enrich our herbaria.

The present little collection consists of 72 numbers, with scarcely any duplicates, comprising 65 species, 60 of which are taken up in the following enumeration, and are referred to 39 genera; 5 of the numbers are too imperfect for determination, and cannot with certainty be even assigned to their natural orders, except one, which is a grass in very young flower-bud.

The collection is too small to enable us fairly to judge of the proportional numbers of species in this flora belonging to the various primary divisions of the vegetable kingdom, or even to the principal natural orders.

Out of the 60 species in 39 genera detailed in the enumeration, 59 species belong to Phanerogamia and 1 only to Cryptogamia; 24 species in 21 genera belong to Dicotyledones, and 35 species in 17 genera to Monocotyledones; in Dicotyledones 3 species in as many genera belong to Thalamifloræ, 9 species in 6 genera to Calycifloræ, 11 species in as many genera to Gamopetalæ, and 1 species to Monochlamydeæ: all the species in the class Monocotyledones belong to the series Glumiferæ.

The Gramineæ of the enumeration contain 25 species in 12 genera; the Cyperaceæ 10 species in 5 genera, the Leguminosæ (the sole representatives of the series Calycifloræ in the enumeration) contain 9 species in 6 genera; the Compositæ, 4 species in as many genera; the Convolvulaceæ and Acanthaceæ contain 2 species each in as many genera; and of the remaining natural orders ,namely Polygaleæ, Caryophylleæ, Tiliaceæ, Rubiaceæ, Apocynaceæ, Verbenaceæ, Illecebraceæ, and Filices, each contains one species.

The numerical preponderance of Monocotyledons over Dicotyledons is fully accounted for by the large proportion of grasses and sedges; and this depended, in all probability, on the comparative ease with which the generality of such plants can be gathered, dried, and conveyed, requiring but little paper for their preservation, taking up a small space, and adding no considerable weight to a traveller's burden. In like manner is to be explained the absence of fleshy or large-foliage plants and of woody or bulky specimens.

Thus there is no specimen in the collection of the "Oúco," a grand tree, which Major Serpa Pinto, on page 361 of the first volume of his book of travels, with reference to the 14th day of August 1878, states is so abundant along the right bank of the river Ninda, and so plentiful in its blossom that for hours and hours the wayfarer is living in an atmosphere of almost overpowering perfume.

This same tree had been found previously, on the 25th day of July 1878, on the right bank of the river Cuchibi, about latitude 14° 3′ south, and longitude 20° 8′ east of Greenwich. An illustration of the plant is given on page 305 of the same volume, figure 66. With regard to it we read, on pages 304–306, as follows:—"While traversing the forest I became conscious of a most delicious and delicate odour, which I found to emanate from the flower of a tree that grew abundantly about me. There is not, perhaps, any known flower that has a more fragrant perfume than the blossom of the 'Oúco' (for by that name do the natives designate the plant). The configuration of the tree, the arrangement of its leaves, the flowers in clusters, and, above all, my ignorance of botany induced me to speak of it in my diary as an Acacia. . . . . This tree, whose delicious flowers many a lady in Europe would have rejoiced to possess, I never met with before reaching this particular spot, and looked for it in vain as I approached the river Ninda."

It appears, however, as before mentioned, that the tree was met with before the river Ninda was left. The figure given in the book shows a zigzag branchlet, bearing alternate abruptly pinnate and apparently stipulate leaves with from 7 to 10 pairs of mostly opposite elliptical and sessile leaflets; the flower (which is enlarged in the figure) possesses 3 stamens, which have slender filiform filaments, bearing oval or oblong versatile anthers, also a slender and filiform style, not quite as long as the filaments, with a capitate stigma at the apex. The flowers are said to form bunches 3 centimetres long by 15 millimetres in diameter; the petals are described as 2 in number and white in colour, and the ovary and stamens as brown.

Such being all the information at our disposal with regard to the "Oúco," and there being no specimen in the collection, it would be rash to speak with any confidence as to the genus to which it belongs. It may, however, be suggested that possibly it may, when better known, eventually prove to belong to the genus *Cryptosepalum*, Benth., of Cæsalpinieæ; and if so, it would be an undescribed species: the specific name *fragrantissimum* would be suitable. If this view is correct, the organs which have been termed petals are really bracteoles.

It must be borne in mind that this branch of the Portuguese expedition to the interior of South Central Africa, which was started in the year 1877, was mainly developed as a geographical exploration, and that its leader, Major Serpa Pinto, did not lay claim to botanical knowledge; moreover, from causes which have been already hinted at, and which are more circumstantially related in his book of travels, it would have been impracticable for him to bring home any considerable herbarium from the interior of the country.

On three separate occasions even this small collection fell into imminent danger of loss or total destruction. First, at Lialui, the capital city of the kingdom of the Barôze, in the Upper Zambesi, close to the 15th parallel of south latitude, on the night of September 6th, 1878, the camp was set on fire by the treachery of native incendiaries, and it was only with great difficulty that the trunks containing the scientific instruments, the papers, and the gunpowder were got out and saved from the general conflagration. Secondly, near the village of Catongo, on September 10th, 1878, the carriers deserted in the darkness of night, and stole nearly all the property. Thirdly, on April 19th, 1879, in transhipping in rough weather off Durban the baggage from a little harbour-steamer to the ocean-steamer, some of the baggage fell and got crushed between the two vessels; a portion of the contents went to the bottom of the sea, and was irretrievably lost.

About a score (being a third part of the number of species set out in the following enumeration) appear to be new or previously undescribed species. Of these plants two are represented in the collection by specimens too imperfect to enable us to speak with complete certainty as to their genus; three others belong to species of grasses which occur also in other parts of Africa, and which have previously received names in manuscript by the late General Munro (though in one of these cases the generic name has been altered in Mr. Bentham's manuscript); one more belongs to a species which had been detected in Extratropical South Africa nearly seventy years ago, and named in manuscript by the late Mr. Burchell, whose name has been herein adopted; one is referred to a new genus, determined and named in manuscript by the late Dr. Welwitsch, and is regarded as belonging to the same species as one of Dr. Welwitsch's plants from Huilla; two more are new species, previously unnamed, and considered to be identical with specimens from Extratropical South Africa; and the remaining eleven are new species not yet known to occur otherwise than in this collection. Seven of the species were known to Linnæus.

The following 4 species of the enumeration are known to occur otherwise than in this collection, but are limited to Tropical Africa and African tropical islands, their previously known distribution being herewith supplied with their names:—

Tetrapleura andongensis, Welw. Pungo Andongo (Angola).

Oldenlandia Bojeri, Hiern. Mozambique district, South-African Gold-fields, Madagascar, and Comoro Islands.

Diplorhynchus psilopus, Welw. Huilla (Angola).

Andropogon insculptus, Hochst. Nileland.

The following 15 species of the enumeration occur also in Extratropical South Africa, but, except this collection, not in Tropical Africa:—

Polygala krumanina, Burch. South Kalahari.

Triumfetta Sondersii. Transvaal and Zululand.

Indigofera heterotricha, DC. South Kalahari, Transvaal, and Zululand.

Helichrysum nudifolium, Less. Cape Colony, South Kalahari, and Natal.

Geigeria Zeyheri, Harv. Transvaal.

Blepharis serrulata, Transvaal.

Kyllingia alba, Nees ab Esenb. South Kalahari and eastern regions of Cape Colony.

Fimbristylis Burchellii. South Kalahari.

Aristida barbicollis, Tr. et Rupr. Eastern districts of Cape Colony, Transvaal, Natal, and Zululand.

A. vestita, Thunb. Cape Colony.

Sporobolus leptostachys. Transvaal.

Eragrostis gummiflua, Nees ab Esenb. Southern and eastern districts of Cape Colony.

E. Lappula, Nees ab Esenb. South Kalahari, Natal, and Zululand.

E. obtusa, Munro. Cape Colony and Transvaal.

Elionurus argenteus, Nees ab Esenb. Eastern districts of Cape Colony.

The following 11 species of the enumeration are found both in Tropical Africa and in Extratropical South Africa, but are not known to occur beyond the limits of Africa and African islands:—

Tephrosia longipes, Meisn. Transvaal, Natal, Delagoa Bay, and Karagué.

Eriosema polystachium, E. Mey. Kaffraria, Natal, Transvaal, Upper Guinea, Nileland, Lower Guinea, and Mozambique district.

Dicoma anomala, Sond. Transvaal, Natal, South-African Gold-fields, and Karagué.

Lantana salvifolia, Jacq. Southern and eastern districts of Cape Colony, South Kalahari, Natal, Transvaal, Angola, and South Central Tropical Africa.

Cyperus margaritaceus, Vahl. South Kalahari, Transvaal, South-African Gold-fields, Upper Guinea, and Damaraland.

Panicum gossypinum, A. Rich. South Kalahari, Natal, and Abyssinia.

P. nigropedatum, Munro. South Kalahari and South-African Gold-fields.

P. insigne, Steud. South Africa and Abyssinia.

Schmidtia quinqueseta, Benth. South Kalahari, Transvaal, Upper Guinea, Nileland, and Mozambique district of Tropical Africa.

Eragrostis elata, Munro. South Kalahari, Orange Free State, Transvaal, Delagoa Bay, and South-African Diamond-fields, also Mozambique district of Tropical Africa and Angola.

Andropogon eucomus, Nees ab Esenb. South-western districts of Cape Colony, Natal, Mozambique district of Tropical Africa, Upper Nileland, and Lower Guinea.

For the purpose of these lists, the South-African Gold-fields, where no precise locality is given, are considered to belong to the south-central district of Tropical Africa. Moreover the Tropical Africa spoken of means that part of Africa contained between the tropics of Cancer and Capricorn; and in this sense it is taken in Professor Oliver's 'Flora of Tropical Africa;' and it is not used to denote the botanical region of "Tropical Africa and Natal" according to Grisebach, which includes part of the Transvaal, also Zululand and Natal, in addition to the part of Africa which is tropical in a geographical sense, with the omission, however, of a portion which belongs to the Kalahari region.

On taking the general indications about the geographical affinities of the flora of this point of the upper Zambesi system which the first two lists above given supply, we may observe that, whereas only 4 species of the enumeration are peculiar to Tropical Africa (in the geographical sense), the various principal districts of that large area being mostly represented, with a slight preponderance in favour of Angola, so many as 15 species occur in Extratropical South Africa, and not again in Tropical Africa; of these 15 species 7 occur in the Transvaal, 7 in Cape Colony, 6 in South Kalahari, 4 in Zululand, and 3 in Natal. Thus, such a limited view would make it appear that the flora of the upper course of the river Ninda is allied to that of Extratropical South Africa rather than to that of the greater part of Tropical Africa; and this alliance is illustrated in the collection by the larger representation of Compositæ as compared with Rubiaceæ. On the other hand the high proportional number of Leguminosæ over that of the former of the other two natural orders points to a peculiarity of the flora of Tropical Africa as contrasted with that of Extratropical South Africa.

From the third list it is found that of the species which are limited to Africa, but which occur both in Tropical Africa and in Extratropical South Africa, 7 species of the enumeration occur in the Transvaal, 7 in Nileland, 6 in South Kalahari, 6 in Natal, 4 in Lower Guinea, 4 in Cape Colony, 4 in South Central Tropical Africa otherwise than in this collection, 4 in the Mozambique district of Tropical Africa, 3 in Upper Guinea, 2 at Delagoa Bay, 1 in Damaraland, 1 in the Orange Free State, and 1 in the South-African Diamond-fields.

Three species of the enumeration occur both in Africa and Asia, but not in Australia, America, or Europe; 3 species occur both in Africa, Asia, and Australia, but not in America or Europe; 1 species occurs in Africa, Asia, and America, but not in Australia or Europe; 5 species occur both in Africa, Asia, Australia, and America, but not in Europe; 3 species occur both in Africa, Asia, Australia, America, and Europe; 1 species occurs in Africa and America only; and 1 species occurs in Africa, Asia, and Europe, but neither in Australia nor America.

The majority of the genera represented in the enumeration are well-known types, with a wide geographical distribution both in the eastern and western hemispheres, and with numerous species; of the genera previously known only 4 are peculiar to Africa, of which one is exclusively tropical, one both tropical and extratropical southwards, and two were only known previously to be south extratropical genera. One new genus is named and fully described below.

The five numbers which are too imperfect for determination are as follows:—

A barren leafy shoot, with sessile leaves, having pellucid veinlets, rather suggestive of a simple-leaved species of *Rhus*: Serpa Pinto, no. 30.

A branch without either flowers or fruit, but with simple alternate oval petiolate stipulate leaves $1\frac{1}{2}$–2 inches long, having parallel erecto-patent lateral veins; the plant is said to produce an edible fruit; nativename "Ulama;" from the high plateau: Serpa Pinto, no. 11.

A barren branch, with crowded narrow leaves: Serpa Pinto, no. 26.

A portion only of a fruit, from the high plateau; native name "Sanarubia": Serpa Pinto, no. 31.

A grass, the upper part of a plant in very young flower-bud: Serpa Pinto, no. 38.

Enumeration of Plants collected.

POLYGALEÆ.

1. Polygala krumanina, Burchell, MS. in Herb. Kew. *P.* perennis suffruticosa ramosissima procumbens trium vel quatuor pollicum alta, ramis teretibus fibratis, ramulis foliosis puberulis pilis brevibus crispulis, foliis alternis lineari-spathulatis, $\frac{1}{3}$–$\frac{1}{2}$ (–$\frac{2}{3}$)-pollicaribus subcoriaceis puberulis vel glabratis uninerviis apice mucronulatis vel obtusis basi angustatis sessilibus margine incrassato-revolutis, floribus lateralibus solitariis (vel in cymis brevibus paucifloris dispositis) bracteatis foliis subæquantibus, pedicellis brevibus, bracteis caducis, sepalis integris interioribus obovatis apiculatis albido-viridibus demum albescentibus carina paulum brevioribus, sepalis interioribus inter se liberis, petalis lateralibus $\frac{2}{3}$ long. carinæ, carina $\frac{1}{5}$-pollicari dorso cristata, crista conspicua multifido-lobata, staminum filamentis superne liberis, capsula ovali $\frac{1}{5}$-pollicari subglabra sepalis interioribus sublatiore apice emarginata sinu ovato lobis ovatis, seminibus pilosis $\frac{1}{8}$-pollicaribus, caruncula $\frac{1}{20}$-pollicari 3-appendiculata.

This species has been previously obtained in the southern part of the Kalahari region of Extratropical South Africa, in the year 1812, by Burchell, nos. 2425, 2474, 2599, as under; in Burchell's specimens the leaves range up to two thirds of an inch in length.

Burchell, no. 2425: near the ruins of the Bachapin town on the Krúman, November 16, 1812. A specimen of this number in the Kew Herbarium is marked by Burchell as having been seen by the eldest DeCandolle; the plant, however, does not appear to have been taken up in DeCandolle's 'Prodromus,' nor in the 'Flora Capensis' of Harvey and Sonder, of which the first volume (the one containing the genus *Polygala*) was published in the year 1860, although in the preface to the 'Flora Capensis' the thanks of the authors are said to be due to Burchell for the verification of several of the species of *Polygala* first described from his specimens.

Burchell, no. 2474: in a walk to the Great Klibbolikhónni Spring (or source of the river Krúman), November 25, 1812.

Burchell, no. 2599: at the Kosi Fountain, on the morning of December 25, 1812. It was at this station that Burchell at the same time obtained specimens of our *Fimbristylis Burchellii*, described below, page 28. The species belongs to the group containing the East-Indian *P. rosmarinifolia*, Wight et Arn.

Serpa Pinto, no. 29.

CARYOPHYLLEÆ.

2. Dianthus Serpæ, sp. n. (Plate III. A. figs. 1, 2.) *D.* subglaber, caulibus bipedalibus vel ultra erectis vel strictim ascendentibus subteretibus ut videtur in specimine nostro unico indivisis unifloris basim versus foliosis, foliis lineari-lanceolatis acutis vel subacutis rigide coriaceis 7–3-nerviis margine scabridulis 2–3 pollices longis superioribus minoribus per paria remotis supremis bracteæformibus $\frac{2}{5}$-pollicaribus, floribus solitariis, bracteis 4 decussatim imbricatis ovatis cuspidatis pari exteriore semipollicari pari interiore $\frac{2}{5}$ poll. longo, calyce rigido tubuloso subcartilagineo striato sesquipollicari tubo fere pollicem longo $\frac{1}{4}$ poll. lato lobis ovato-lanceolatis acutis erectis, petalis spathulatis lamina obovata acuta inciso-fimbriata subpollicari ut videtur albida ungue calycem æquante, ovario $\frac{2}{5}$ poll. longo.

Our specimen consists only of a flowering stem or branch; it bears some resemblance to *Dianthus prostratus*, Jacq.; but it differs from it by the more acute form of the general outline of the blade of the petals, and by the more deeply cut margins of the same.

The principal figure in Plate III. A. represents the natural size of the specimen; the dissected flower is enlarged to about two diameters.

Serpa Pinto, no. 24.

TILIACEÆ.

3. Triumfetta Sonderii, nobis. *T. trichocarpa*, Sond. in Linnaea, xxiii. p. 19 (1850); Harv. in Harv. et Sond. Fl. Cap. i. p. 228 (1860); non Hochst. (1847).

Our specimens possess flowers and fruits, and quite agree with Sonder's species, which has also been obtained from the Transvaal and Zululand. In a flower opened for examination the stamens were 18 in number. Hochstetter's *T. trichocarpa*, from Abyssinia, is quite distinct.

Serpa Pinto, no. 27.

LEGUMINOSÆ.

4. Crotalaria erisemoides, sp. n. *C.* suffruticosa inermis dense ramosa villosa pilis albidis ut videtur nana, ramis teretibus demum glabratis ramulis tenuibus hirtis foliosis, foliis digitatim trifoliolatis petiolatis hirtis, foliolis obovato-ellipticis ciliatis utrinque acutatis supra glabris infra villosis sæpe (in sicco) conduplicatis integer-

rimis subsessilibus lateralibus fere semipollicaribus centrali ceteris leviter majore, petiolo hirto tenui $\frac{1}{5}$–$\frac{1}{3}$-pollicari, stipulis foliaceis integerrimis $\frac{1}{4}$–$\frac{1}{3}$-pollicaribus ciliatis, floribus axillaribus vel lateralibus solitariis vel geminis brevissime pedunculatis cernuis $\frac{3}{8}$–$\frac{1}{3}$-pollicaribus, calyce profunde fisso extus hirto corollam circiter æquante lobis lanceolatis acutis inter se subæqualibus, staminibus 10 monadelphis tubo superne partito, ovario compresso oblique obovato $\frac{1}{5}$-pollicari villoso multiovulato, stylo basi supra ovarium abrupte incurvo glabro, legumine subcompresso villoso oblique ovali $\frac{3}{8}$-pollicari, funiculis filiformibus, seminibus circiter 14–18.

The species to which our plant has nearest affinity appears to be *C. Forbesii*, Baker in Oliv. Fl. Trop. Afr. ii. p. 18 (1871).

Serpa Pinto, no. 3.

5. Indigofera heterotricha, DC. Prodr. ii. p. 227, n. 61 (1825); Harv. in Harv. et Sond. Fl. Cap. ii. p. 189 (1862).

This species occurs also in Extratropical South Africa, having been found in the year 1812 in the southern part of the Kalahari region by Burchell as under, at Magalisberg in the Transvaal by Burke and Zeyher in the year 1841, and in Zululand by Miss Owen.

Burchell, no. 2526, on the road from Little Klibbolikhonni and the (Great) Kosi Fountain, on the morning of December 20, 1812; here Burchell also collected *Panicum gossypinum*, A. Rich., given in the enumeration below, page 29.

Burchell, no. 2635,; at the (Kora) Klip Fontein, December 29 and 30, 1812; caules hispidi fruticosi erecti, folia pinnata 5-juga, racemi fructiferi longissimi axillares (Burch. MS.). On this number of Burchell DeCandolle founded the species.

In our specimens, which are rigidly herbaceous rather than shrubby, the leaflets vary from 7 to 11 (rarely 6) in number; the calyx measures about $\frac{1}{8}$ inch, and the membranous nearly glabrous corolla measures about $\frac{1}{3}$ inch in length.

Serpa Pinto, no. 28.

6. Indigofera dodecaphylla, sp. n. *I.* cinereo-canescens inermis primum subaureonitescens palmaris vel ultra basi frutescens, caulibus hispido-pubescentibus leviter sinuosis subangularibus, foliis pinnatis strigoso-hispidis subsessilibus vel brevipetiolatis $\frac{3}{4}$–$1\frac{1}{4}$-pollicaribus, stipulis subulatis hispido-pubescentibus $\frac{1}{8}$–$\frac{1}{7}$-pollicaribus, petiolo cum rhachi hispido-pubescente, foliolis 7–13 sæpius 11–12 alternis vel suboppositis cum terminali brevi-petiolulato ovalibus vel obovatis apice obtusis mucronatis basi plus minusve angustatis brevissime petiolulatis supra hispido-strigosis infra appresse pilosis $\frac{1}{3}$–$\frac{2}{5}$-pollicaribus, racemis axillaribus sub floribus folia æquantibus sub fructibus sesqui vel bis excedentibus densifloris, pedunculo semipollicari, calyce $\frac{1}{6}$-pollicari piloso-pubescente profunde lobato lobis subulatis inter se subæqualibus, corolla calycem parum excedente, staminibus 10 diadelphis antheris parvis apiculatis, ovario pubescente, stylo glabro, legumine lineari-oblongo obtuse tetragono pubescente pilis crispulis albidis semipollicari, seminibus pluribus.

The closest affinity of this species appears to be with *I. daleoides*, Benth., a plant belonging to the Transvaal, Zululand, and Benguella.

Serpa Pinto, no. 7.

7. INDIGOFERA SPLENDENS, sp. n. (Plate III. B. figs. 3–12.) *I.* inermis, ramis apice canescentibus breviter pubescentibus subherbaceis plus minusve flexuosis, foliis pinnatis sæpius imparipinnatis erecto-patentibus internodia ter vel quater excedentibus petiolo $\frac{1}{5}$–$\frac{1}{3}$-pollicari incluso $1\frac{1}{2}$–3 pollices longis, stipulis lanceolato-subulatis petiolum subæquantibus, foliolis 6–11-jugis oppositis ovalibus utrinque obtusis sæpe mucronulatis integerrimis breviter petiolulatis $\frac{3}{10}$–$\frac{2}{5}$ poll. longis supra glabratis vel subglabris infra appresse canescenti-pubescentibus, stipellis brevibus glandulæformibus rubentibus glabris, racemis spicæformibus axillaribus et quasi-terminalibus breviter pedunculatis densifloris rectis rigidis breviter pubescentibus pedunculo $\frac{1}{2}$–$\frac{3}{4}$-pollicari incluso $1\frac{1}{2}$–$3\frac{1}{2}$ pollices longis, bracteolis caducis, floribus $\frac{5}{8}$–$\frac{2}{3}$-poll. brevissime pedicellatis, calyce profunde lobato extra pubescente intra glabro lobis lanceolatis $\frac{1}{8}$–$\frac{1}{6}$-poll., corolla pro genere magna splendente, staminibus diadelphis antheris uniformibus parvis apiculatis, legumine (immaturo) oblongo recto appresse pubescente $\frac{1}{4}$-pollicari.

This species is allied to *Indigofera sutherlandioides*, Welw., and to *I. fulgens*, Baker; it differs from the former by its large flowers, and from the latter by its dense racemes and smaller foliage.

The principal figure in Plate III. B represents the natural size of a flowering branch; the portion of the leaf, the detached flower, and the separate petals are enlarged to two diameters or rather more; the andrœcium, shown with the calyx persisting, and also the detached pistil, are enlarged to about four diameters; the anther, with part of the filament, is still more enlarged; the young legume is somewhat enlarged.

Serpa Pinto, nos. 1 and 4.

8. TEPHROSIA LONGIPES, Meisn. in Hook. Lond. Journ. Bot. ii. p. 87 (1843); Harv. in Harv. et Sond. Fl. Cap. ii. p. 208 (1862); Baker in Oliv. Fl. Trop. Afr. ii. p. 120 (1871); Grant et Oliv. in Trans. Linn. Soc. Lond. xxix. p. 56 (1872).

This species occurs also in Natal, in grassy places at the base of the Tafelberg Mountains, at an elevation of 1500 feet; in the Transvaal; at Delagoa Bay; and in Karagué, about 2° S. lat., at an elevation of 4500 feet.

Serpa Pinto, no. 2.

9. TEPHROSIA PURPUREA, Pers. Syn. Pl. ii. p. 329 (1807); DC. Prodr. ii. p. 251, n. 12 (1825), cum syn.; Baker in Oliv. Fl. Trop. Afr. ii. p. 124 (1871), cum syn.; Baker in Hook. f. Fl. Brit. Ind. ii. p. 112 (1876), cum syn. *T. lineata*, Schum. et Thonn. in Schum. Beskr. Guin. Pl. p. 376 (1827), et in Dansk. Vid. Selsk. Nat. iv. p. 150 (1829).

Our specimen, which is in young flower, is much more pubescent than most of the forms of this species. The type specimen of *Cracca purpurea*, L. Sp. Pl. edit. i. p. 752

(1753), on which *Tephrosea purpurea*, Pers., is supposed to have been based, has been specially inspected in the Linnean herbarium for comparison with our specimen; the resemblance, however, is by no means close.

The species is widely distributed over the Tropics.

Serpa Pinto, no. 8.

10. ERIOSEMA POLYSTACHIUM, E. H. F. Mey. Comm. Pl. Afr. Austr. Drège, p. 130 (1835). *E. polystachyum* E. Mey., ex Krauss in "Flora," Jahrg. 27, 1844, p. 357 et Beitr. Fl. Cap. und Nat. p. 55 (1846); non Baker. *Rhynchosia cajanoides*, Guill. et Perr. in Guill. Perr. et A. Rich. Fl. Senegamb. Tent. i. p. 215 (1833). *Eriosema cajanoides*, Hook. f. et Benth. in Hook. Niger Fl. p. 314 (1849); Harv. in Harv. et Sond. Fl. Cap. ii. p. 261 (1862); Baker in Oliv. Fl. Trop. Afr. ii. p. 227 (1871), cum syn.

Our specimens are in flower and fruit, and quite accord with this handsome species, which occurs also in other districts of Tropical Africa, and extends to the Transvaal, Kaffraria, and Natal (among reeds near the river Umlaas).

Serpa Pinto, no. 5.

11. BAUHINIA SERPÆ, sp. n. *B.* molliter velutina ramosa, (in sicco) fulvo-fusca, ramulis erecto-patentibus, foliis transverse ovalibus bifidis chartaceis utrinque molliter pubescentibus apice in sinu setaceo-cuspidatis basi profunde cordatis margine anguste revolutis, superioribus $1\frac{1}{2}$–2 poll. lat., $1\frac{1}{4}$–$1\frac{1}{2}$ poll. long., lobis vel foliolis 2 oblique ovalibus rotundatis tricostatis secus folii costam $\frac{1}{2}$–$\frac{5}{8}$ poll. connatis, petiolo $\frac{1}{5}$–$\frac{1}{4}$-pollicari, stipulis lineari-lanceolatis acutis deciduis $\frac{1}{3}$-poll., floribus fere bipollicaribus, pedunculo oppositofolio solitario subpollicari apice bracteolato, pedicello solitario vel subsolitario incrassato vel compresso-dilatato 1–$1\frac{1}{2}$-pollicari, calyce breviter pubescenti-velutino $1\frac{1}{8}$ poll. longo, lobis apiculatis fere usque ad apicem in tubum ovoideo-oblongum connatis, petalis fere 2 pollices longis $\frac{1}{2}$–$\frac{2}{3}$ pollices latis ovali-oblongis margine crispo-dentatis unguiculatis lamina in unguem $\frac{1}{5}$-pollicarem abrupte angustata, staminibus perfectis quinque 1–$1\frac{1}{2}$ poll. longis filamentis inter se inæqualibus sub apice pubescentibus antheris $\frac{1}{4}$–$\frac{3}{8}$-poll., staminibus anantheris 5 in phalangem pubescentem semipollicarem connatis, ovario $\frac{3}{4}$-pollicari in gynophoro semipollicari suffulto stylo $\frac{1}{2}$-pollicari stigmate hemisphærico capitato, fructibus teste cl. Serpa Pinto edulibus.

Habitat in regione alto-plana; nomen vernaculum "Quieira."

This species appears to have its nearest affinity with *B. macrantha*, Oliv., a species from South Central Africa.

Serpa Pinto, no. 9.

12. TETRAPLEURA ANDONGENSIS, Welw., ex Oliv. Fl. Trop. Afr. ii. p. 331 (1871); Benth. in Trans. Linn. Soc. Lond. xxx. p. 376 (1875).

Habitat in regione alto-plana; nomen vernaculum "Mulolo."

Our specimen consists only of a leaf, but appears to accord well with this species, which was found by Welwitsch, no. 618, in the high forests at the base of the rocks of

Pedras de Guinga, Pungo Andongo, Angola, in March 1857. Welwitsch states that the plant has the habit of an *Acacia* of the group of *A. læta*, Br.

Serpa Pinto, no. 6.

Another specimen, consisting only of part of a leaf, may possibly belong to the same species; it also occurred on the high plateau; its local name is "Chipa."

Serpa Pinto, no. 10.

RUBIACEÆ.

13. Oldenlandia Bojeri, Hiern in Oliv. Fl. Trop. Afr. iii. p. 53 (1877), cum syn.

Our specimens are in flower, and are small forms of the species, which occurs also in the Mozambique district of Tropical Africa, in the South-African Gold-fields, in the island of Madagascar, and in the Comoro Islands.

Serpa Pinto, no. 25.

COMPOSITÆ.

14. Amphidoxa filaginea, sp. n. (Plate IV. figs. 1–10.) *A.* herbacea argenteo-canescens semipedalis habitu spisso a basi ramosissima erecta capite globoso demum obsolete sericeo-tomentella, caudice suffruticoso, ramis ramulisque erectis vel ascendentibus apice argenteis lanato-tomentellis foliosis, foliis alternis sublinearibus obtusiusculis sessilibus subamplexicaulibus persistentibus basim versus paulum latioribus $\frac{1}{8}$–$\frac{1}{3}$-pollicaribus primum appressis demum patulis ramis ramulisve concoloribus crassiusculis marginibus plus minusve involutis, capitulis campanulatis $\frac{1}{8}$–$\frac{1}{6}$-pollicaribus heterogamis discoideis multifloris sessilibus subsessilibusve basi pallido-fuscis sublanatis apice niveis glabris 2–5nis in glomerulis terminalibus subterminalibusque aggregatis, bracteis involucri pauciserialibus imbricatis obtusis interioribus lineari-oblongis $\frac{1}{8}$–$\frac{1}{6}$-pollicaribus corollas excedentibus supra medium niveis glabris apice subradiantibus exterioribus ovatis brevioribus basi extra sublanatis, floribus ♀ ∞ filiformibus epapposis, floribus ⚥ interioribus circiter 9–11 sterilibus (?) papposis tubulosis, antheris apice appendiculatis basi breviauriculatis minute caudato-appendiculatis, granulis pollinis globosis tuberculatis styli florum ⚥ ramis apice truncatis inappendiculatis, achæniis ovali-oblongis subglabris minutissime papillosis, setis pappi paucis (3–5) setaceo-clavatis sursum plumoso-barbellatis, receptaculo nudo parvo.

The general appearance of the plant (in the dried state) is like that of *Helichrysum declinatum*, Less. It constitutes a second species of the genus to which it belongs, the first species being a Cape and Natal plant, with linear-spathulate leaves.

The principal figure in Pl. IV. represents the natural size of the whole of our specimen; the detached flower-head is enlarged to five diameters; the piece of a branchlet with two leaves is enlarged to about six diameters; the separate florets are enlarged to about thirty diameters.

Serpa Pinto, no. 14.

15. Helichrysum nudifolium, Less. Syn. Gen. Comp. p. 299 (1832); DC. Prodr. vi.

p. 200, n. 163 (1837); Harv. in Harv. et Sond. Fl. Cap. iii. p. 240 (1865). *Gnaphalium nudifolium*, L. Pl. Afr. Rar. n. 56 (1760) in Amoen. Acad. vi. p. 99 (1763).

Our specimen is a very good one. The type specimen in the Linnean herbarium has been specially examined for the identification of our specimen. The species has an extensive distribution throughout Cape Colony, and extends to South Kalahari and Natal. It was not previously known to occur in Tropical Africa.

Serpa Pinto, no. 16.

16. Geigeria Zeyheri, Harv. in Harv. et Sond. Fl. Cap. iii. p. 126 (1865).

In our specimen the involucral bracts are less produced into leafy tips than usual in this species, though examples like ours occur in other specimens. The species has previously been obtained from the Transvaal.

Serpa Pinto, no. 15.

17. Dicoma anomala, Sond. in Linnæa, xxiii. p. 71 (1850); Harv. in Harv. et Sond Fl. Cap. iii. p. 517 (1865); Oliv. et Hiern in Oliv. Fl. Trop. Afr. iii. p. 443 (1877), cum syn.

This species, with its varieties, occurs also in the Transvaal and Natal, in the upper part of Nileland, and in the South-African Gold-fields. Our specimens, which are viscid-glandular, agree best with the variety *α. Sonderi* of Harvey.

Serpa Pinto, no. 17.

APOCYNACEÆ.

Diplorhynchus, Welw. MS., gen. nov.

Calyx 5-fidus campanulatus parvus eglandulosus, lobis ovatis obtusiusculis inter se subæqualibus basi leviter imbricatis. *Corolla* urceolari-infundibularis profunde 5-fida alba, tubo supra medium paulum ampliato ore subconstricto, fauce gibbis seu squamis dentiformibus adnatis applicatisve aucta, lobis ovali-oblongis patentibus demum recurvis intra laxe puberulis in æstivatione dextrorsum (ab axe deorsum spectanti) convolutis. *Stamina* 5 inclusa glabra medio corollæ tubo inserta cum lobis corollæ alternantia, filamentis brevibus, antheris triangulari-pyramidatis apiculatis luteis a stigmate liberis apicibus conniventibus loculis basi polliniferis obtusis inappendiculatis. *Discus* obsoletus vel inconspicuus brevis annularis glaber. *Ovarium* superum depresso-globosum glabrum 2-loculare, carpellis 2 separabilibus biovulatis vel rarius quadriovulatis, stylo unico albido basi sæpe fisso, stigmate viridi quam stylus multo latiore cupuliformi medio intra cupulum materiam stigmatoideam rubram ovato-conicam bilobam ferente, ovulis superpositis, placentis ventralibus. *Folliculi* gemini a basi distincti divergentes lignosi vel crasse coriacei subcompressi ovales aperte dehiscentes. *Semina* inquoque folliculo 2 vel rarius 4 superposita plano-compressa peltatim affixa apice late alata.

Arbores vel frutices scandentes vel stantes, glabri, sæpe lactescentes. Folia opposita vel subopposita, sempervirentia, delicate reticulata, coriacea, lucida. Flores parvuli, fragrantes, in cymis terminalibus multifloris pyramidato- vel globoso-corymbosis dispositi. Folliculi $1\frac{1}{2}$–$1\frac{3}{4}$-pollicares.

Species adhuc cognitæ 3, Africæ tropicæ australis incolæ.

Besides the species described below, there are two other species, one from the Mozambique district (Benth. in Hook. Ic. Pl. t. 1355, ined.), the other from Angola (Welw. hb. nn. 5968, 5983, 5984).

The affinity of this genus is with *Gonioma*, E. Mey., from which it differs by the different shape of the corolla with longer lobes, and by the presence of adnate teeth or gibbosities within the throat, by definite ovules and seeds, and by the opposite or subopposite not verticillate leaves.

18. DIPLORHYNCHUS PSILOPUS, Welw. MS. in Herb. n. 5982. (Plate V. figs. 1–9.) *D.* ramis in sicco brunneo-rubescentibus teretibus, ramulis foliosis, foliis oppositis vel rarius ultimis subsparsis suboblique ovalibus apice obtuse acuminatis retusisve basi plus minusve cuneatis petiolatis tenuiter coriaceis nitidis eleganter reticulatis 1–2 pollices longis $\frac{1}{2}$–1 poll. latis, costa venisque leviter pellucidis, petiolo $\frac{1}{3}$–$\frac{1}{2}$-poll. angustissime alato sæpe (in sicco) unilateraliter verso, cymis laxe ramosis semiglobosis 2–2$\frac{1}{2}$ poll. diam., pedunculo $\frac{1}{8}$–$\frac{2}{3}$-pollicari, pedicellis minute puberulis approximatis $\frac{1}{8}$-poll., bracteolis parvis, alabastris cylindraceis $\frac{1}{4}$-poll., floribus $\frac{1}{6}$-poll., calyce minute puberulo, corolla extus glabra, ovulis in quoque carpello 2 superpositis.

Habitat in regione alto-plana ; nomen vernaculum " Mussala Canjanga."

The description given above is taken from our specimens. According to a note made by Major Serpa Pinto the fruit is edible; but this statement does not appear to be probable, at least in the case of Welwitsch's specimens; the latter appear to belong to the same species, though in those plants the habit is more robust, the leaves range up to 3 inches in length by 1$\frac{2}{3}$ inch in width, the petioles to 1 inch in length, the inflorescence is less lax, and often of smaller diameter, the pedicels are more conspicuously puberulous and some of them are shorter, and the unopened flowers range up to $\frac{1}{3}$ inch in length; the follicles open nearly flat, are broadly oval, retuse at the apex, 2-seeded, and measure 1$\frac{1}{2}$ inch long by 1$\frac{1}{5}$ inch wide; the pericarp is hard, and very thickly leathery, warted outside, smooth and chestnut-coloured inside ; the seeds measure 1 inch long by $\frac{2}{5}$ inch wide. The following is a copy of Welwitsch's manuscript notes appended to his number 5982 :—" Arbor parva, nunc frutex scandens, nunc arbuscula stans uno alterove ramo scandente ; folia sempervirentia coriacea lucida ; flores albi fragrantissimi ; planta lactescens. Habitat (distr. Huilla) in editioribus collinis prope Nene una cum Combretaceis, Octobr. 1859, c. fl. et fr."

Of the genus the other species obtained by Welwitsch in Angola is called by the Portuguese colonists " Jasmineira " or " Jasmin de Cazengo."

The principal figure in Plate V. represents the natural size of a flowering branch of Major Serpa Pinto's plant; the detached flower and flower-bud are enlarged to about four diameters; the other dissections are more considerably enlarged.

Serpa Pinto, nos. 12 and 13.

CONVOLVULACEÆ.

19. IPOMŒA ANGUSTIFOLIA, Jacq. Collect. ii. 367 (1788), et Ic. Pl. Rar. ii. t. 317 (1786–1793); non Choisy. *Ipomœa filicaulis*, Blume, Bijdr. Fl. Ned. Ind. p. 721 (1825); Choisy in DC. Prodr. ix. p. 353, n. 31 (1845), cum syn.; Benth. in Hook. Niger Fl. p. 466 (1849).

This species is widely spread over Tropical Asia, Africa, and Australia; it also occurs in Extratropical South Africa.

Serpa Pinto, nos. 18, 19.

20. Evolvulus alsinoides, L. Sp. Pl. edit. ii. p. 392 (1762); Choisy in DC. Prodr. ix. p. 447, n. 40 (1845); Benth. et Muell. Fl. Austral. iv. p. 438 (1869); Grant et Oliv. in Trans. Linn. Soc. Lond. xxix. p. 117 (1875). *Evolvulus linifolius*, L. *l. c.*.; Choisy, *l. c.* p. 449, n. 50.

This is a common tropical species, and subject to much variation of form. The type specimens in the Linnean herbarium have been specially inspected for comparison. Our specimen is a form with very slender stems and branches and small leaves, thus approaching the typical form of *E. alsinoides*, L., but with the narrowly lanceolate shape of its leaves as in *E. linifolius*, L.

Serpa Pinto, no. 20.

ACANTHACEÆ.

21. Blepharis serrulata, nobis.—*Acanthodium serrulatum*, Nees ab Esenb. in DC. Prodr. xi. p. 275, n. 8 (1847).

The species quoted above occurs in the Transvaal. The type, collected by Burke, in the Kew herbarium agrees with our specimen. The specimen of Burchell, quoted by Nees *l. c.*, we do not find in the Kew herbarium; the name of Burchell was probably printed by mistake for Burke. The species does not appear to have been noted by T. Anderson, in Journ. Linn. Soc. Lond. vii. p. 34 (1863), among the South-African species of the genus.

Serpa Pinto, no. 22.

22. Crabbea ovalifolia, sp. n. (Plate VI. A. figs. 1–6.) *C.* herbaceo-suffruticosa procumbens puberula, caulibus teretibus breviter pubescentibus ut videtur prostratis simplicibus, foliis ovalibus integris vel subrepandis puberulis rigide membranaceis, in sicco secundis erectis, apice obtusis vel obtusiusculis basi angustatis 2–3 pollices longis $\frac{2}{3}$–$1\frac{1}{4}$ poll. latis, petiolo $\frac{1}{4}$–$\frac{2}{5}$-pollicari robusto breviter pubescente, internodiis $\frac{3}{8}$–$1\frac{1}{4}$-poll., floribus fere pollicaribus capitatis sessilibus in spicis abbreviatis bracteosis subhemisphæricis axillaribus solitariis secundis erectis breviter pedunculatis congestis, bracteis lanceolatis acutis subpollicaribus calyces excedentibus herbaceis basi imbricatis involucrantibus breviter pubescentibus margine spinuloso-ciliatis ciliis albido-ciliolatis, bracteis nullis nisi flores abortivos simulantibus minoribus, calyce $\frac{3}{8}$-pollicari 5-partito hirsuto segmentis anguste lanceolatis acutis parum inter se inæqualibus, corolla $\frac{4}{5}$-pollicari extra atque intra ad faucem et staminum insertionem puberula tubo $\frac{5}{8}$-pollicari cylindraceo-infundibuliformi ad faucem paulum oblique ampliato limbo 5-lobo oblique patulo lobis rotundatis $\frac{1}{8}$ poll. longis in æstivatione imbricatis, staminibus 4 didynamis inclusis infra medium tubum insertis filamentis glabris per paria inæquilongis longioribus $\frac{1}{8}$-pollicaribus brevioribus $\frac{1}{10}$-pollicaribus antheris ciliolatis bilocularibus muticis, disco brevi oblique cupulari

glabro, pistillo semipollicari glabro incluso stylo gracili stigmate oblique dilatato, ovario biloculari loculis 2–3-ovulatis.

Nearly related to the Natal species, *Crabbea hirsuta*, Harv., from which it differs by broader leaves and by the more conspicuous hoary hairs on the bracts.

The principal figure in Pl. VI. A. represents the natural size of the specimen; the detached flower is enlarged to two diameters; and the other more detailed dissections are more considerably enlarged.

Serpa Pinto, no. 21.

VERBENACEÆ.

23. Lantana salvifolia, Jacq. Hort. Schœnbr. iii. p. 18, t. 285 (1798). *L. salviæfolia*, Schauer in DC. Prodr. xi. p. 605, n. 41 (1847), cum syn.

This species is widely distributed over both Tropical and Extratropical South Africa.

Serpa Pinto, no. 23.

ILLECEBRACEÆ.

24. Genus vix adhuc descriptum.

Flores hermaphroditi in capitulum terminale solitarium bracteolatum aggregati. *Perianthium* inferum siccum 5-phyllum; segmenta erecta lineari-oblonga vel linearia imbricata quincuncialia apiculata chartacea margine scariosa apice excepto lanata carinata trinervia, exteriora latiora sublongiora lanatiora. *Corolla* nulla. *Stamina* 5 subhypogyna inter se subæqualia glabra perianthio subbreviora; filamenta complanata tenuia basim versus dilatata ad basim connata; antheræ biloculatæ oblongæ. *Ovarium* superum ovoideum ventricosum basi excepta lanatum 1-loculatum apice distylum; stylus alter filiformis glaber perianthio subæquilongus apice minute capitatus stigmatosus, alter abbreviatus externe lanatus corniculatus abortivus. *Ovulum* pendulum e funiculo longo apice curvo a basi ovarii ascendente.

Herba facie graminea, foliis supremis oppositis anguste linearibus sessilibus valde acutis pollicaribus.

The affinity of the genus appears to be with *Cometes*, L., which consists of two species, one belonging to North-eastern Africa and Tropical Arabia, the other to Persia. We refrain from giving a new name till more of the plant is known.

Our specimen consists of the upper portion of the plant, 4 inches long, unbranched; the stem is straight and grass-like, about 10-striate, subterete, slender, of a pale yellowish green colour, very nearly glabrous, except the uppermost part above the only pair of leaves extant on the specimen. Leaves more erect than spreading, nearly straight, minutely scabrid on the margin. Stipules none or fallen. Capitulum ovoid, $\frac{1}{2}$ in. long, not quite as much in thickness, bracteolate, mixed with white cottony wool; peduncle $\frac{1}{2}$ in. long, clothed with short white woolly hairs, bearing rather above the middle a pair of opposite ovate-acuminate caducous sessile 1-nerved bracts with green midrib and broad scarious margins, measuring $\frac{1}{6}$ in. in length. Flowers indefinite, crowded, sessile. Bracteoles ovate-lanceolate or linear, apiculate, cottony at the back, glabrous on the inner face, about as long as the flowers, with broad scarious margins. Perianth-segments $\frac{1}{6}$–$\frac{1}{5}$ in. long.

Serpa Pinto, no. 64.

CYPERACEÆ.

25. KYLLINGIA ALBA, Nees ab Es. in Linnæa, x. p. 140, n. 4 (1836); Boeck. in Linnæa, xxxv. p. 430, n. 28 (1868). *K. cristata*, Kunth, Enum. Cyperac. p. 136 (1837). *Kyllingia* sp., Burchell, 'Travels in the Interior of Southern Africa,' i. p. 538, note (1822).

This species occurs also in Extratropical South Africa, having been found by Ecklon, Zeyher, and Drège, in the eastern regions of Cape Colony, at an elevation of 3500 to 4000 feet, and in the southern part of the Kalahari region by Burchell, no. 1997, between Wittewater (or Gattekamma) and Aakaap (or Riet Fontein), on the morning of 15 February 1812. "Capitula alba."

Serpa Pinto, no. 65.

26. CYPERUS AUREUS, Humb. et Kunth (emend.), var. β. *aurantiacus*, Boeck. in Linnæa, xxxv. p. 495, n. 64 β (1868).

This is a widely distributed tropical species. Our specimen is without leaves, but appears to belong here.

Serpa Pinto, no. 69.

27. CYPERUS ARISTATUS, Rottb. Gram. p. 23, t. 6. f. 1 (1773); Kunth, Enum. Cyperac. p. 23 (1837); Steud. Syn. Pl. Cyperac. p. 14, n. 132 (1855); Boeck. in Linnæa, xxxv. p. 500, n. 71 (1868).

This species occurs also in the East Indies, in both North and South America, in Senegambia, in Nileland, in Angola, in Damaraland, and in the Cape flora.

Serpa Pinto, no. 68.

28. CYPERUS, sp.

In our specimen, which is glabrous and without lower leaves, the stem is 6 inches long, smooth, striate, rather glossy and naked, at the apex with a pair of patent linear-subulate floral leaves 3-nerved and clasping at the base and rough-edged towards the apex, measuring respectively $\frac{1}{3}$ and $1\frac{1}{4}$ in.; the sessile spikelets are 6 in number, and measure from $\frac{1}{4}$ to $\frac{3}{5}$ in., oblong or lanceolate-oblong, radiating in a hemispherical manner, compressed, 2-edged, glossy, reddish-brown in the dry state, 13–33-flowered; the scales are rounded above with a short straight projecting apiculus, halfboat-shaped, with a small keel; the style is trifid, and the caryopsis ovoid, smooth, and very roundedly trigonous.

It appears to be an undescribed species nearly related to *Cyperus amnicola*, Kunth, Boeck. in Linnæa, xxxv. p. 509, n. 84, errore 83 (1868), and to *C. rupestris*, Kunth, Boeck., *l. c.* p. 510, n. 85, which are Cape and Natal species.

Serpa Pinto, no. 66.

29. CYPERUS MARGARITACEUS, Vahl, Enum. Pl. ii. p. 307 (1806); Kunth, Enum. Cyperac. p. 46 (1837); Steud. Syn. Pl. Cyperac. p. 28, n. 294 (1855); Boeck. in Linnæa, xxxv. p. 529, n. 110 (1868). *C. eburneus*, Thonn. ex Boeck., *l. c.* p. 530. *Cyperus*

sp., Burchell, Travels in the Interior of Southern Africa, vol. i. p. 538, note (1822).

This species has a wide distribution in Africa, occurring also in Upper Guinea, in the Transvaal, in the South-African Gold-fields, and in Damaraland, also in the southern part of the Kalahari region, as under :—

Burchell, no. 1992. "Parvus, spiculis albis." Between Klaarwater (or Kárrikamma) and Wittewater (or Gáttikamma), 14th February 1812.

Burchell, no. 2613. "Planta basi cæspitosa, basibus foliorum pseudo-bulbosa; culmus setaceus, folia setacea excedens; spiculæ 2–4, lanceolatæ, albæ." Between Knegt's Fontein and Klip Fontein, on the morning of 26th December 1812. It was at this place and at this time that Burchell also collected *Panicum nigropedatum*, Munro, given in the enumeration below, page 29.

Serpa Pinto, no. 61.

30. Cyperus rotundus, L. Fl. Zeylan. n. 36 (1747); L. Sp. Pl. edit. i. p. 45 (1753); Kunth, Enum. Cyperac. p. 58 (1837); Steud. Syn. Pl. Cyperac. p. 32, n. 351 (1855); Caruel, Prodr. Fl. Tosc. p. 670 (1864); Boeck. in Linnæa, xxxvi. p. 283, n. 213 (1869); var.?

Our specimen has extant none of the lower leaves of the plant; and its specific identification must remain uncertain. The species named is widely dispersed over most hot and warm countries; and numerous varieties occur. The type specimen in Hermann's Ceylon herbarium, part of the Banksian collection in the British Museum, has been compared; and in it the scales are more strongly ribbed than in our specimen.

Serpa Pinto, no. 67.

31. Scirpus nindensis, sp. n. *S.* cæspitosus minute hirtellus bipollicaris vel tripollicaris, radicibus fibrosis capillaribus, culmis numerosis capillari-filiformibus rectis erectis vel suberectis valde inæqualibus nonnullis brevissimis angulari-sulcatis minute scabrido-hirtellis longioribus 2–3-pollicaribus folia longiora vix excedentibus basi foliatis, foliis inæqualibus longioribus capillari-filiformibus acutis canaliculatis dorso sulcatis carinatis minute hispidulo-hirtellis basim versus dilatato-vaginantibus margine membranaceis sparse ciliatis, vaginis brevibus fissis pallide fuscis, spiculis solitariis terminalibus anguste ovoideo-oblongis acutiusculis $\frac{1}{8}$–$\frac{1}{4}$-pollicaribus plurifloris, bracteis nullis vel squamas simulantibus, squamis imbricatis ovatis longe apiculatis erectis glabris vel puberulis demum glabris inferioribus longioribus dorso viridi-carinatis lateribus pallidis fuscescentibus, staminibus 3, caryopsi parva late obovoidea obtuse triquetra pallida vel subfusca transversim rugosula, angulis linea elevata lævi fusca notatis, apice tuberculo minimo persistente notata, stylo trifido exserto.

Nearly related to *Scirpus sphærocarpus*, Boeck. in Linnæa, xxxvi. p. 741, n. 107 (1870), but differs by the 3-sided not globose fruit &c.

Serpa Pinto, no. 63.

32. Fimbristylis (§Oncostylis) Burchellii, sp. n. (Plate VI. B, figs. 7–15.) *F.* cæspitosa spithamæa vel ultra superne glabriuscula, radicibus fibrosis tenuibus, culmis pluribus gracilibus filiformibus infirmis erectis vel nutantibus angularibus sulcatis basi foliosis, foliis setaceo-filiformibus quam culmi sæpius bis vel ter brevioribus canaliculatis dorso subcarinatis basim versus fuscis dilatato-vaginantibus, vaginis brevibus ore pilis longis caducis vestitis, inflorescentia umbelliformi composita vel semicomposita pluriradiata $\frac{3}{4}$–$1\frac{1}{2}$ poll. longa, radiis erecto-patentibus filiformi-capillaribus exterioribus longioribus, radiolis brevibus nonnullis brevissimis capillaribus erecto-patentibus, involucri foliolis imbricatis basi fuscis dilatato-amplexicaulibus laxe pilosulis infimo quam umbella bis breviore superioribus iterum brevioribus, spiculis ovali-oblongis leviter compressis 8–14-floris $\frac{1}{8}$–$\frac{3}{8}$-pollicaribus, squamis adpressis aridis oblongo-ovalibus imbricatis obtusis vel breviter apiculatis dorso (in sicco) rubescenti-fuscis carina convergenter 3-nervi ad apicem squamæ evanescente vel excurrente margine scariosis, caryopsi minima late obovata obtuse triquetra pallida lævi, bulbo stylino minutissimo depresso fusco, stylo trifido tenui apice exserto.

This species occurs also in the southern part of the Kalahari region of South Africa, having been found by Burchell as under :—

Burchell, no. 2151, at the Klip Fontein (or Rock Fountain), in the country of the Kóras, on dry naked rocks, 19th June 1812. This number of Burchell's collection has been referred by Dr. Boeckeler, in Linnæa, xxxvii. p. 28 (1871), to *Fimbristylis hispidula*, Kunth, a species which belongs to the section *Trichelostylis*, and to which he ascribes a wide distribution over Africa. The specimens measure 8–16 inches in length, and the leaves $2\frac{1}{2}$–5 inches. It was here and at this time that Burchell gathered *Pellæa calomelanos*, Link, given in the enumeration below, page 34.

Burchell, nos. 2589, 2598, at the Kosi Fountain, 25th December 1812. These specimens measure about $7\frac{1}{2}$ inches in length, and the leaves 4–$5\frac{1}{2}$ inches. It was at this station that Burchell at the same time obtained specimens of his *Polygala krumanina*; see page 16.

The species appears to be nearly related to *Scirpus Schweinfurthianus*, Boeck. in Linnæa, xxxvi. p. 758, n. 125 (1870).

The principal figure in Pl. VI. B, represents the natural size of one of Major Serpa Pinto's specimens; the detached spikelet is enlarged to about five diameters; and the dissections are more considerably enlarged.

Serpa Pinto, nos. 60, 62.

33. Fuirena pubescens, Kunth, Enum. Cyperac. p. 182, n. 11 (1837); A. Rich. Tent. Fl. Abyss. ii. p. 497 (1851); Steud. Syn. Pl. Cyper. p. 126, n. 12 (1855); Boeck. in Linnæa, xxxvii. p. 104, n. 8 (1871); vel affinis.

The species quoted occurs in Portugal, Corsica, and other parts of the Mediterranean region, the East Indies, Nileland, and the Cape of Good Hope. Our specimen differs from the type by the more squarrose setæ of the spikelets.

Serpa Pinto, no. 70.

34. FUIRENA sp.? aff. *F. pubescenti*, Kth.

Our specimen is without lower leaves. The inflorescence is much denser than in the last; the spikelets are longer ($\frac{3}{8}$–$\frac{1}{2}$ in.); and the setæ are long, firm, and straight. It appears to belong to an undescribed species.

Serpa Pinto, no. 71.

GRAMINEÆ.

35. PASPALUM SCROBICULATUM, L. Mant. i. p. 29 (1767); Kunth, Enum. Gram. i. p. 53, n. 89 (1833); Steud. Syn. Pl. Gram. p. 21, n. 74 (1855).

This species is widely dispersed over the tropical regions of the Old World, including Australia.

Serpa Pinto, no. 55.

36. PANICUM CILIARE, Retz. Obs. iv. p. 16, n. 42 (1786); Kunth, Enum. Gram. i. p. 82 (1833); A. Rich. Tent. Fl. Abyss. ii. p. 360 (1851); Steud. Syn. Pl. Gram. p. 39, n. 20 (1855), cum syn.

Our specimen is without leaves, but agrees with this widely-spread species.

Serpa Pinto, no 44.

37. PANICUM GOSSYPINUM, A. Rich. Tent. Fl. Abyss. ii. p. 366 (1851), cum syn.; Steud. Syn. Pl. Gram. p. 56, n. 281 (1855).

Our specimen is without leaves, and must be compared with *Panicum serratum*, Br., a closely allied Cape species. Richard's species occurs also in Abyssinia and Natal, and in other parts of Extratropical South Africa. It has been found by Burchell in the southern part of the Kalahari region as under:—

Burchell, no. 2186, at the Kruman station, June 30, 1812. Burchell, no. 2543, on the road from Little Klibbolikhonni and the (Great) Kosi Fountain, December 20, 1812; here Burchell also collected *Indigefera heterotricha*, DC., given in the enumeration above, page 18.

Serpa Pinto, no. 46.

38. PANICUM NIGROPEDATUM, Munro, MS. in Herb. Kew.

The type of this species belongs to the southern part of the Kalahari region of South Africa; it was found by Burchell as under:—

Burchell, no. 2391, on the rocks at the Chue Spring, October 7, 1812.

Burchell, no. 2577, at the Kosi Fountain, December 24, 1812.

Burchell, no. 2610, between Knegts Fontein and Klip Fontein, December 26, 1812: "stirps bipedalis, erecta, tota pubescenti-mollis; folia ciliata; spiculæ dense albido-hirtæ; locustæ petiolus ater; folia velutina ut etiam bases radicales; perennis" (Burchell MS.). It was at this place and at this time that Burchell also collected *Cyperus margaritaceus*, Vahl, given in the enumeration above, page 26. This grass has also been collected by Baines in the South-African Gold-fields, 1870.

Allied to *Panicum serratum*, Br., and *P. gossypinum*, A. Rich., but well distinguished; the black foot-stalks of the spiculæ are curious. (Monro, MS. in Herb. Kew.)

Serpa Pinto, no. 41.

39. PANICUM MAXIMUM, Jacq. Ic. Pl. Rar. i. p. 2, t. 13 (1781); Steud. Syn. Pl. Gram. p. 72, n. 469 (1855); vel aff.

Our specimen is hirsute on the sheath of the uppermost leaf, is a less robust form; and the inflorescence is less umbellate than is usual in this species, which is widely spread over the tropics, and is said originally to have been native on the African continent; it also occurs at Natal.

Serpa Pinto, no. 43.

40. PANICUM INSIGNE, Steud. Nomencl. Bot. edit. 2, pars ii. p. 258 (1841); Steud. Syn. Pl. Gram. p. 92, n. 747 (1855). *Tricholæna grandiflora*, Hochst. in Herb. Schimp. Abyss. i. n. 205; A. Rich. Tent. Fl. Abyss. ii. p. 445 (1851).

This species occurs also in Abyssinia and South Africa.

Serpa Pinto, nos. 36, 50.

41. ARISTIDA BARBICOLLIS, Trin. et Rupr. Sp. Gram. Stip. p. 151 (1842); Steud. Syn. Pl. Gram. p. 141, n. 106 (1855). *Chætaria Forskolii*, Nees ab Es. Fl. Afr. i. p. 188 (1841), excl. syn.

This species occurs also in eastern districts of the Cape of Good Hope, in Natal, in the Transvaal, and in Zululand.

Serpa Pinto, no. 45.

42. ARISTIDA VESTITA, Thunb. Prodr. i. p. 19 (1794); Kunth, Enum. Gram. i. p. 197, n. 74 (1833); Steud. Syn. Pl. Gram. p. 142, n. 113 (1855).

This species occurs also in other parts of South Africa.

Serpa Pinto, no. 49.

43. SPOROBOLUS LEPTOSTACHYS, sp. n.

Our specimen is without leaves, but is sufficient for the determination of the genus, and differs from the described species of this genus. The specimen in the dry state is of a pale straw-colour throughout; the portion of the stem extant is terete, smooth, glabrate, shining, slightly wavy near the top below the spike, and measures, exclusive of the spike, $7\frac{1}{2}$ in. The spike is very narrowly cylindrical, $4\frac{1}{3}$ in. long, $\frac{1}{5}$ in. diam., terete, and without bracts at the base; the rhachis is marked with decurrent lines from the insertion of the spikelets. The spikelets are subsessile, narrow, more or less spreading, in many rows, $\frac{1}{10}$ in. long; pedicel very short, very shortly puberulous; glumes 1-nerved, about as long as the spikelet.

It is nearly related to *Sporobolus spicatus*, Kunth, Enum. Gram. i. p. 210, n. 1 (1833) (that is, to *Vilfa spicata*, Vahl), and appears on superficial examination to be identical, or nearly so, with a specimen in the Kew Herbarium from the Apies river, Transvaal, collected by Nelson, no. 102, partim.

Serpa Pinto, no. 58.

44. Schmidtia quinqueseta, Benth. MS. in Herb. Kew., vel affinis.

This species, which our species approaches, or perhaps belongs to, is illustrated by specimens which have been distributed from the Polytechnic School of Lisbon as part of the herbarium of Dr. A. R. Ferreira. It occurs also in Senegambia; in the Mozambique district, having been collected by Dr. J. Kirk at Shiramba, in dry plains, in January 1860; in the Transvaal, having been collected by Dr. W. G. Atherstone and by Mr. McLea in plains; in dar-Fur, at Gebel Sungur, distr. Surutj, having been collected by Dr. T. Pfund, no. 617, September 23, 1875; and in the southern part of the Kalahari region of Extratropical South Africa, having been collected by Burchell, no. 2361, in a walk from Giraffe Station to the First Camelopardalis, October 3, 1812. This species was referred in manuscript by Munro to a different genus. It differs from the original species of the genus, which belongs to the Cape-Verd Islands, by the more spreading and conspicuous setæ of the spikelets.

In our specimen, which is without foliage, the inflorescence is less dense and less highly compound, and the setæ, though conspicuous, yet are less spreading than in the types of *S. quinqueseta*. The genus was described by Steudel in J. A. Schmidt's 'Beiträge zur Flora der capverdischen Inseln,' pp. 144, 145 (1852), and consists, as at present known, only of the species mentioned above.

Serpa Pinto, no. 34.

45. Triraphis sp.?, vel affinis.

In our specimen the flowers are in very young bud, and there are no leaves; it, however, seems to be near or to belong to this genus, which is at present known to consist of 5 species from Australia (See 'Bentham and Mueller's Flora Australiensis,' vol. vii. pp. 603–605 (1878)), and of one species from the Caledon river, in Extratropical South Africa.

Serpa Pinto, no. 59.

46. Chloris petræa, Thunb. Prodr. Pl. Cap. i. p. 20 (1794); Steud. Syn. Pl. Gram. p. 207, n. 59 (1855). *Eustachys petræa*, Desv. Journ. de Bot. 1813, i. 69; Kunth, Enum. Gram. i. p. 262 (1833), cum syn.

This species has a wide distribution, occurring also in the Cape districts, in the Orange Free State, in the West Indies, and in the southern states of North America. It is also given as an Abyssinian plant by Schweinfurth and Ascherson in Schweinfurth's 'Beitrag zur Flora Æthiopiens,' i. p. 298, n. 3505 (1867).

Serpa Pinto, no. 57.

47. Eragrostis gummiflua, Nees ab Esenb. Fl. Afr. Austr. i. p. 393 (1841); Steud. Syn. Pl. Gram. p. 271, n. 111 (1855); vel affinis.

Our specimen is without leaves, but appears to belong to this species, which is known from the southern and eastern districts of the region of the Cape of Good Hope.

Serpa Pinto, no. 48.

48. Eragrostis Lappula, Nees ab Esenb. Fl. Afr. Austr. i. p. 412 (1841); Steud. Syn. Pl. Gram. p. 272, n. 130 (1855).

This species occurs also in Natal and Zululand, whence the forms seen exhibit a denser inflorescence than our specimen; also with a lax inflorescence, as in our specimen, and as illustrated by a specimen collected in the southern part of the Kalahari region by Burchell, no. 2199, between the river Makkwarin and Sikkloniani Fountain, July 10, 1812.

Serpa Pinto, no. 40.

49. Eragrostis obtusa, Munro, MS. in Herb. Kew. *Briza geniculata*, Thunb. Prodr. Pl. Cap. i. p. 21 (1794); Kunth, Enum. Gram. i. p. 372, n. 10 (1833); Steud. Syn. Pl. Gram. p. 282, n. 6 (1855).

This species occurs also at the Cape of Good Hope and in the Transvaal.

Serpa Pinto, no. 47.

50. Eragrostis elata, Munro, MS. in Herb. Kew.

This species has been confused by authors with *Eragrostis brizoides*, Nees ab Esenb. in Linnæa, vii. p. 328 (1832); it differs by its flatter and broader spikelets, with acute margins; it has a wide distribution, occurring also in Angola, Mozambique, at Delagoa Bay, in the Transvaal, Natal, Orange Free State, South-African Diamond-fields, and in the southern part of the Kalahari region.

Serpa Pinto, no. 32.

51. Eragrostis nindensis, sp. n. *E.* subglabra nitida, culmis infra paniculam subteretibus nudis strictis minutissime scabridis intra paniculam angulosis apicem versus leviter flexuosis, panicula ad 5 poll. longa anguste pyramidato-oblonga racemoso-composita sublaxa apicem versus simplici ramis alternis in axillis pilosulis inferioribus 1–$1\frac{2}{3}$ poll. longis laxis superioribus gradatim brevioribus, spiculis lineari-oblongis compressis alternis $\frac{1}{2}$–$\frac{2}{3}$ poll. longis $\frac{1}{8}$–$\frac{1}{7}$ poll. latis 15–21-floris patentibus breviter pedicellatis extremis erectis pedicellis longioribus suffultis, gluma floris late ovata obtusiuscula subapiculata rigide chartacea trinervia carinata glabra $\frac{1}{8}$ poll. longa, palea ovali obtusiuscula glabra bicarinata lateribus plicatis glumæ subæquilonga.

Our specimen is without leaves, but appears to be closely allied to *Eragrostis chalcantha*, Trin., and *E. sclerantha*, Nees ab Esenb., both of which are species occurring in southern and eastern districts of the Cape of Good Hope; it differs from both of them by longer spikelets and laxer inflorescence. It agrees, however, better with a specimen in the Kew Herbarium collected by Burke from the Caledon river, in the Orange Free State, which may belong to our species.

Serpa Pinto, no. 51.

Another specimen, collected by Major Serpa Pinto, no. 35, differs from his no. 51 by a shorter, denser, and more highly compound inflorescence, with spikelets ranging up to $\frac{3}{4}$ in. long, bearing rather more numerous flowers (21–26) and more obtuse paleæ; it may, however, belong to the same species, and, if so, would so far enlarge or modify the characters of the species given above.

52. Imperata arundinacea, Cyr. Pl. Rar. Regn. Neapol. fasc. ii. p. 27, t. 11 (1792); Kunth, Enum. Gram. i. p. 477 (1833), cum syn.; Steud. Syn. Pl. Gram. p. 405, n. 1 (1855); Caruel, Prodr. Fl. Tosc. p. 695 (1864); Benth. et Muell. Fl. Austral. vii. p. 536 (1878).

This species is very widely spread over the warmer countries of the world, including Italy and Australia.

Serpa Pinto, no. 56.

53. Heteropogon hirtus, Pers. Syn. Pl. ii. p. 533 (1807); non Ands. ex Schweinf. et Aschers. in Schweinf. Beitr. Fl. Æthiop. i. p. 310 (1867). *Andropogon contortum*, L. Sp. Pl. edit. i. p. 1045, n. 1 (1753); Kunth, Enum. Gram. i. p. 486, n. 2 (1833); Steud. Syn. Pl. Gram. p. 367, n. 37 (1855); Benth. et Muell. Fl. Austral. vii. p. 517 (1878). *Heteropogon contortus*, Roem. et Sch. Syst. Veg. ii. p. 836 (1817).

This species extends over the warmer parts of both the Old and New Worlds, including Australia; but it does not occur in any part of Europe.

Serpa Pinto, no. 42.

54. Elionurus argenteus, Nees ab Esenb. Fl. Afr. i. p. 95 (1841). *Andropogon tenuifolius*, Steud. Syn. Pl. Gram. p. 365, n. 15 (1855).

The species occurs also in Extratropical South-eastern Africa. Our specimen is quite destitute of leaves; and we are not sure of the correctness of its identification.

Serpa Pinto, no. 37.

55. Andropogon insculptus, Hochst. in Herb. Schimp. Abyss. i. n. 80; A. Rich. Tent. Fl. Abyss. ii. 458 (1851); Steud. Syn. Pl. Gram. p. 380, n. 205 (1855).

Our specimen is without leaves, but appears to be identical with the above-mentioned species, which has previously been found in Abyssinia and Gallabat.

Serpa Pinto, no. 54.

56. Andropogon anthistirioides, Hochst. in Herb. Schimp. Abyss. iii. nn. 1822, 1832; A. Rich. Tent. Fl. Abyss. ii. p. 463 (1851); Steud. Syn. Pl. Gram. p. 386. n. 283 (1855).

The species occurs also in Abyssinia, and is probably a variety of *Andropogon cymbarius* (L.), a species which extends from the East Indies to Nileland and South Africa. Our specimen is without lower leaves.

Serpa Pinto, no. 53.

57. Andropogon Schœnanthus, L. Sp. Pl. edit. i. p. 1046, n. 6 (1753); Kunth, Enum. Gram. i. p. 493, n. 51 (1833); Steud. Syn. Pl. Gram. p. 387, n. 296 (1855); Benth. et Muell. Fl. Austral. vii. p. 534 (1878).

This species, with its varieties, is widely spread over the hotter parts of the Old World, and extends to Australia. The type specimen in the Linnean herbarium has been inspected for comparison.

Serpa Pinto, no. 33.

58. Andropogon eucomus, Nees ab Es. Fl. Afr. Austr. i. p. 104 (1841); Steud. Syn. Pl. Gram. p. 390, n. 331 (1855); Grant et Oliv. in Trans. Linn. Soc. Lond. xxix. p. 176 (1875). *Eriopodium Kraussii*, Hochst. ex Krauss in Flora, Jahrg. 29, 1846, p. 115, et Beitr. Fl. Cap- und Natall. p. 186 (1846).

This species occurs also in Lower Guinea, the upper part of Nileland, the Mozambique district, Natal, and the south-western districts of the Cape of Good Hope.

Serpa Pinto, no. 39.

59. Andropogon punctatus, Roxb. Fl. Ind. ed. Carey, i. p. 268 (1820); Kunth, Enum. Gram. i. p. 506, n. 137 (1833); Steud. Syn. Pl. Gram. p. 391, n. 343 (1855).

This species occurs also in other parts of Africa and in India.

Serpa Pinto, no. 52.

FILICES.

60. Pellæa calomelanos, Link, Fil. Hort. Berol. p. 61 (1841); Hook. Bot. Mag. t. 4769 (1854); Hook. Sp. Fil. ii. p. 140 (1858), cum syn.; Hook. et Baker, Syn. Fil. p. 152 (1868).

This species occurs also in the Cape flora at an elevation of 400-4000 feet in rocky situations, in the Transvaal and Natal, in the Mozambique district and Lower Guinea, also in the island of Bourbon, and at an elevation of 4000–6000 feet among the Himalaya mountains; it is also reported from Abyssinia.

Burchell found this fern in the southern part the Kalahari region, in the same locality as our *Fimbristylis Burchellii*, described above, page 28.

Serpa Pinto, no. 72.

DESCRIPTION OF THE PLATES.

Plate III.

A. Figures 1 & 2. *Dianthus Serpæ*, Ficalho et Hiern.

Fig. 1. The whole specimen, folded in two places, natural size.
2. The flower dissected, the calyx and four of the petals having been removed, enlarged to two diameters.

B. Figures 3–12. *Indigofera splendens*, Ficalho et Hiern.

Fig. 3. A flowering branch, natural size.
4. A portion of a leaf, bearing a pair of leaflets, enlarged to two diameters.
5. A detached flower, enlarged to two diameters.
6. The standard detached from the flower, enlarged to about two diameters.
7. A wing-petal detached, enlarged to rather more than two diameters.
8. The keel detached, enlarged to rather more than two diameters.
9. The flower after the removal of the petals, showing the andrœcium, enlarged to four diameters.
10. An anther with a piece of its filament, enlarged to about eight diameters.
11. The pistil detached, enlarged to about four diameters.
12. A young legume, enlarged to about two diameters.

Plate IV.

Amphidoxa filaginea, Ficalho et Hiern.

Fig. 1. The whole specimen, natural size.
2. A frustum of a branch, bearing two leaves; enlarged to six diameters.
3. A detached capitulum, enlarged to five diameters.
4. One of the inner bracts of the involucre detached, as seen from the inner side, enlarged to nearly thirty diameters.
5. A female floret, enlarged to thirty diameters.
6. The upper part of the style of a female floret, enlarged to about fifty diameters.
7. A hermaphrodite floret, enlarged to about thirty diameters.
8. Part of the andrœcium of a hermaphrodite floret, enlarged to about fifty diameters.
9. The style of a hermaphrodite floret, enlarged to about thirty diameters.
10. One of the setæ of the pappus of a hermaphrodite floret, enlarged to about forty diameters.

Plate V.

Diplorhynchus psilopus, Welw.

Fig. 1. A flowering branch, natural size.
2. A detached flower, enlarged to four diameters.
3. The same before expansion, enlarged to four diameters.
4. The interior of a flower laid open, enlarged to about five diameters.
5. Front view of a stamen, enlarged to about twelve diameters.
6. Side view of a stamen, enlarged to about twelve diameters.
7. The flower after the removal of the corolla, enlarged to about eight diameters.
8. The pistil, enlarged to nearly twelve diameters.
9. The ovary cut transversely, showing the ovules in position, enlarged to about twelve diameters.

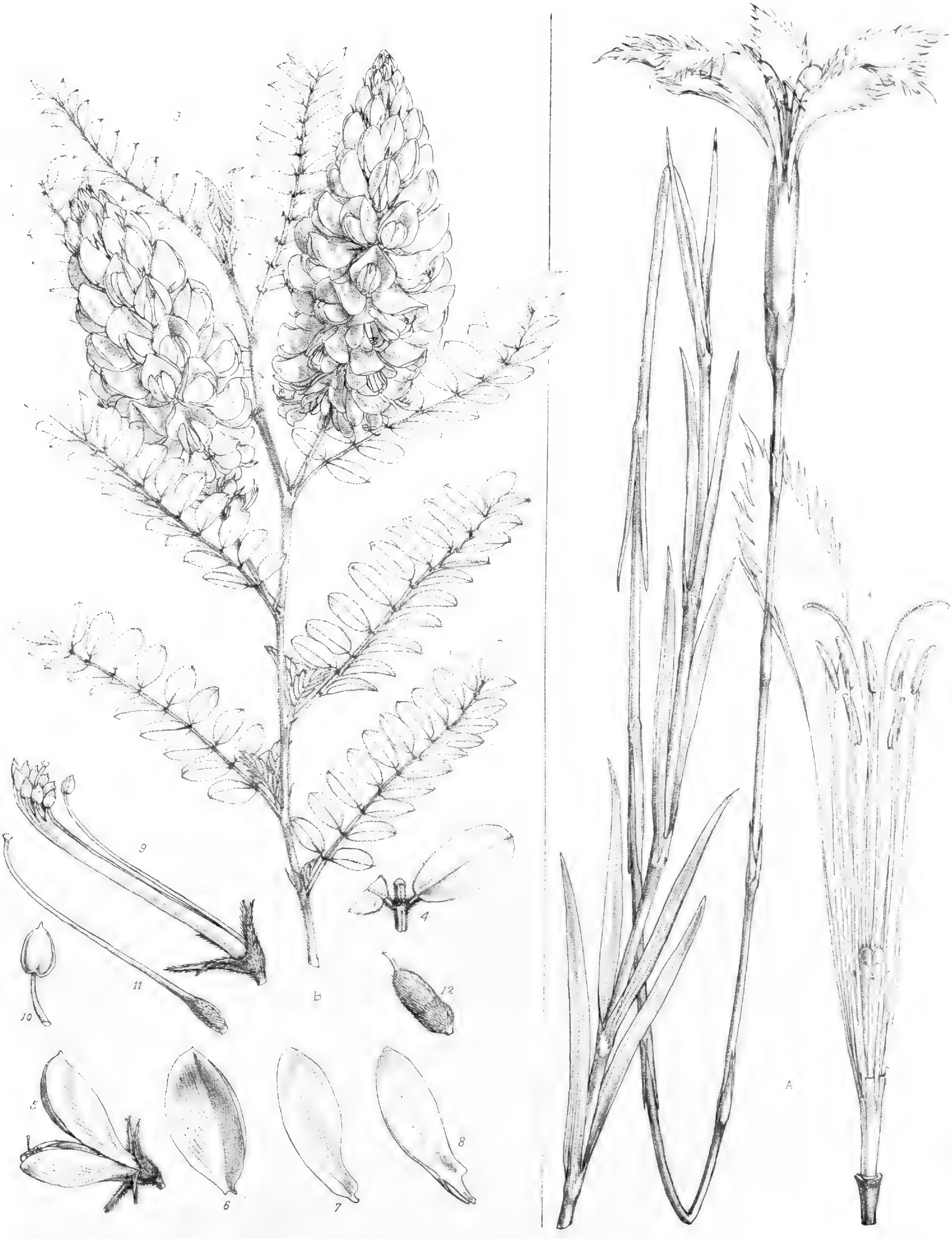
Plate VI.

A. Figures 1–6. *Crabbea ovalifolia*, Ficalho et Hiern.

Fig. 1. The whole specimen, natural size.
2. A detached flower, with a subtending bract, enlarged to about two diameters.
3. The interior of a flower laid open, enlarged to about three diameters.
4. Nearly front view of one of the stamens, enlarged to about eight dimeters.
5. Nearly side view of one of the stamens, enlarged to about eight diameters.
6. The pistil, enlarged to nearly six diameters.

B. Figures 7–15. *Fimbristylis Burchellii*, Ficalho et Hiern.

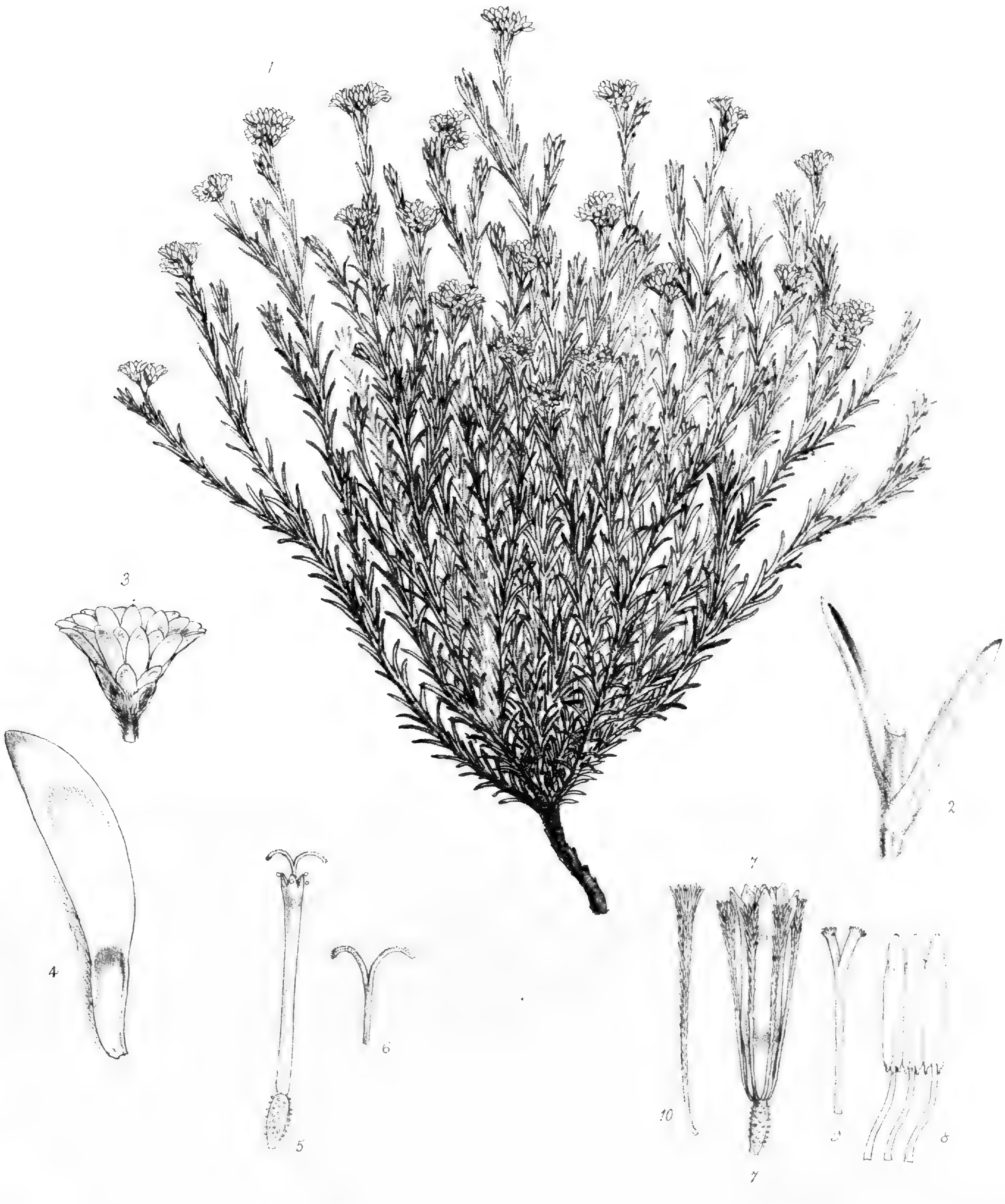
7. A specimen of the whole plant, natural size.
8. The upper portion of a leaf, enlarged to about ten diameters.
9. A spikelet detached, enlarged to about five diameters.
10. A flower detached from the spikelet, with its scale, enlarged to about twenty diameters.
11. The back view of a scale, enlarged to about twenty diameters.
12. A detached flower, enlarged to about thirty diameters.
13. A fruit, enlarged to about thirty diameters.
14. The same, cut across the middle, enlarged to about thirty diameters.
15. A seed, enlarged to about thirty diameters.



W H Fitch del. et lith.

Hanhart imp.

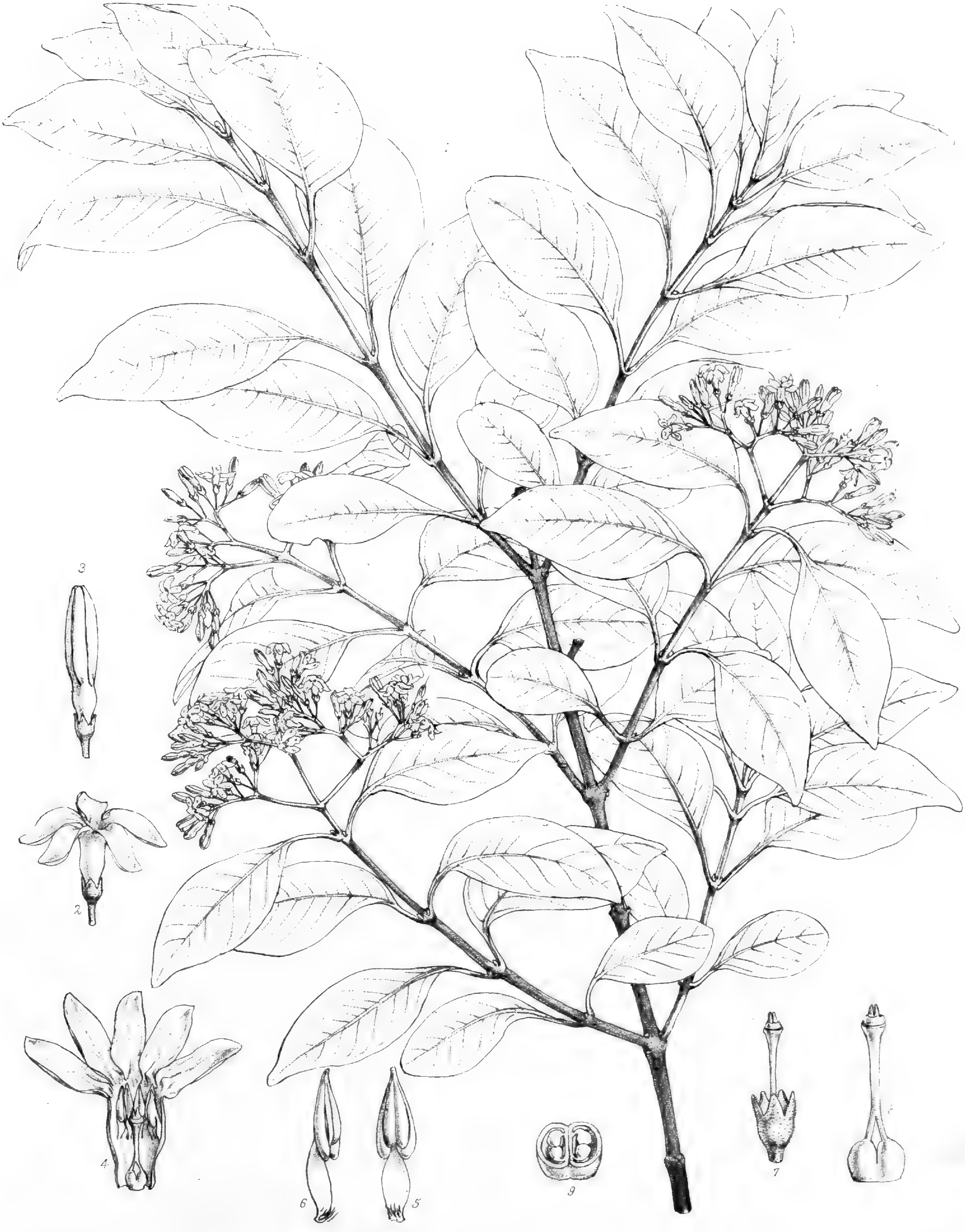
A. DIANTHUS SERPÆ, *Fclh. et Hrn.*



W.H.Fitch del et lith.

AMPHIDOXA FILAGINEA, *Fclh. et Hrn.*

Hanhart imp



W.H.Fitch. del.et lith.

Hanhart imp

DIPLORHYNCHUS PSILOPUS, *Welw.*

W H Fitch del et lith

Hanhart imp

A. CRABBEA OVALIFOLIA, *Fclh. et Hrn.*
B. FIMBRISTYLIS BURCHELLII, *Fclh. et Hrn.*

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Part II.	1881.	0	15	0	0	11	6
Part III.	1881.	1	8	0	1	1	0

2nd Ser. BOTANY.] [VOL. II. PART 2.

THE

TRANSACTIONS

OF

THE LINNEAN SOCIETY OF LONDON.

CONTRIBUTION

TO THE

LICHENOGRAPHIA OF NEW SOUTH WALES.

BY

CHARLES KNIGHT, F.L.S.

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December 1882.

III. *Contribution to the Lichenographia of New South Wales.* *By* CHARLES KNIGHT, *F.L.S.*

(Plates VII.–IX.)

Read March 2nd, 1882.

THE Lichens to which the following descriptions relate form part of a collection made by me in the neighbourhood of Sydney *. I was led to make the collection on receiving the interesting paper of the Rev. Mr. Crombie on the Australasian Lichens in Robert Brown's herbarium †. I am not aware that any other papers on the Lichens of New S. Wales have been published. Several of the species included in the present paper are of considerable interest, especially those arranged under the genus *Stigmatidium.*

The Lichens collected in the neighbourhood of Sydney, New S. Wales, are interesting in the variety of new species, and in their raising important questions of classification.

I have thought it best to give drawings of the spores of all the Lichens which are new or interesting. The descriptions are rather full, in order to meet the requirements of the two schools of lichenologists. Characters which would be ample for the followers of one school would be quite inadequate for the others. But where drawings are given of any structure or part, it is not of much importance which school may eventually gather within its folds the great body of observers; and we may reasonably hope, with Dr. Beale, in 'How to work with the Microscope,' that those who follow us will look at our drawings, if we are careful to make honest copies of nature. Some of the spores are beautiful objects under the microscope—for instance, those of *Lecidea callispora* (sp. n.) and *Platygrapha albo-vestita* (sp. n.). Others furnish excellent specific differences, as in those of the several *Stigmatidia*; while the extreme length of the spores of *Verrucaria rhaphispora* (sp. n.) render it impossible to confound that Lichen with any other Australian *Verrucaria.* The measurements given are those of the normal size of spores *in situ.*

Generally, in the young ascus, the spores would be somewhat less in size; on the other hand the dimensions would occasionally be found above the average if the spores *free* in the field of the microscope are taken. In respect of the spores of *Bacidiæ*, and especially in the case of Lichens whose spores, comparatively speaking, are of huge dimensions, as in some *Pertusariæ, Ochrolechiæ*, &c., the variations in size are much more frequent, especially *in length*, and may differ widely from the average. I have made no use of chemical reagents. A classification eminently natural should not in any way be founded on a chemical basis. The chemical properties of a Lichen may doubtless

* A set of the Lichens is deposited in the Kew Herbarium; and another has also been forwarded to the Rev. W. A. Leighton, Shrewsbury.

† Journ. Linn. Soc. Botany, vol. xvii. pp. 390–401.

be changed or influenced by its matrix, from which it draws nourishment; and plants which differ *only* in their chemical properties should be considered to be the same. Dr. Lindsay, in his valuable paper on "Chemical Reaction as a specific character in Lichens," comes to the conclusion that the frequent uncertainty of results, the inconstancy of colour-reaction even in the same species, render it impossible to place confidence in chemical characters as a means of diagnosing botanical species.

The number of species collected of the genus *Stigmatidium*, viz. eight, in a collection of about sixty species, is worthy of notice. Dr. Nylander, in 'Synopsis Lichenum Novæ Caledoniæ,' mentions only three species in a collection of 220 Lichens; and among these it is observed that he includes *Stigmatidium elegans*, whose apothecia are elongate and dendritico-ramose. If this arrangement be admitted, we should include also among the New S. Wales species *Graphis subtricosa* and *Graphis subintricata*. The genera *Graphis* and *Stigmatidium* require revision. I have consulted the last edition of the 'Lichen Flora of Great Britain,' and have followed Leighton's definition.

The generic place of *Lecanora corysta* (sp. n.) is uncertain. The apothecia are crowded together in sets of four or five; a thin section of the apothecia shows that they are separated from each other only by the slight intervention of scattered gonidia without a trace of a proper excipulum. A further exploration in New South Wales may discover other allied species; until then it can conveniently remain among the *Lecanoræ*.

Aphtholoma conspicua (sp. n.) is still more perplexing. The singular capillary texture of the white tubercles in which the apothecia are immersed, and the black torus springing from the matrix, are charcters widely different from those of any Lichen known to me.

Not less interesting is *Platygrapha albo-vestita* (sp. n.); the white thin thalline covering of the irregular-shaped disk of the apothecia gives it very much the aspect of a *Graphis*, while the great size of the solitary murali-divided spores furnishes a most distinctive character.

Lecanora parella, L. It is observed that Dr. J. Müller, in Flora, No. 39, p. 484, advocates the transfer of this Lichen, with its allied species, to the genus *Pertusaria*. It is well to notice how, one after another, the Lichens arranged under Dr. Nylander's sections, "Stirps Lecanoræ cinereæ et L. tartareæ," are being transferred to *Pertusaria*. There are others left for similar treatment—for instance, *Lecanora verrucosa* and *L. calcarea*. In respect of *Lecanora bryontha*, Th. Fries (in 'Lich. Scand.' p. 314) transfers it to *Pertusaria*, an arrangement which the extraordinary thickness of the parietes of the solitary spores and the clathratim-ramose paraphyses amply support; on the other hand the thin envelope of the spores of *L. parella* is an obstacle in the way of the proposed transfer to a genus quite remarkable for the great thickness of the sporal envelope. It may be added that the intricate ramose paraphyses and double envelopes of the large spores of *Lecanora gemmifera*, Th. Fries, render it likely that it too belongs to the genus *Pertusaria*.

Lecanora punicea, Ach., might conveniently be placed in Massalongo's genus *Hæmatomma*. The many septate acicular spores support the arrangement of those lichenologists who have removed the allied species *Lecanora ventosa*, Ach., *L. coccinea*, Dicks., and *L. elatina*, Ach., to that new genus. Koerber states that the apothecia of *Hæmatomma* are margined by a compound excipulum—that is, by a proper and by a thalline excipulum. There exists no proper excipulum in *L. punicea*, the hymenium being simply imbedded in the thallus. Th. Fries, in 'Lich. Scand.' p. 296, makes no reference to the existence of a double excipulum in the *Hæmatomma*; his words are, "apothecia thallode saltem primitus cincta;" and this omission seems to be made advisedly on revision of his earlier publication, 'Genera Heter. Eur. recognita,' p. 67, where the excipulum is stated to be double.

Parmelia speciosa, Wulf. In the New S. Wales specimens the spores are either 1-septate or pseudo-polari-bilocular, or pseudo-4-locular. The normal state both in the European and Australian Lichen is pseudo-polari-bilocular. The 3-septate spores, occasionally met with, are resolved into 1-septate by the action of glycerine, showing that there exists only one true septum.

Arthonia nymphæoides (sp. n.). In connexion with the remarks above on the paraphyses of the *Pertusariæ*, I would draw attention to Dr. J. Müller's statement in the 'Flora' (April 11, 1879), that paraphyses are always present in the *Arthoniæ*, "at valde tenellæ clathratim pauciramosæ." This, however, requires qualification. Hitherto the absence of paraphyses is the main character on which the genus is based. In a few species where the thalamium is said to be grumose or homogeneo-grumose, there exists no trace of stratification, the structure being devoid of filaments, as in *A. nymphæoides* of the present paper; or the strictly cellular structure may be so crowded together and condensed that it becomes rude and columnar, as in *A. globulosæformis*, Hepp, *A. lurida*, Ach., *A. Kempelhuberi*, Mass., &c. Again, in other cases distinct filaments are found, more or less clathriramose, and the texture more open, as in *A. gregaria*, Ach., *A. Swatziana*, Ach., *A. Oleandri*, &c.

Parmelia sphærospora (sp. n.). The black, coarse, adpressed, radiating hairs around the base of the apothecia are in striking contrast with the light-coloured thalline border. I cannot call to mind any similar appendage ornamenting the apothecia of any other Lichen.

I make no remarks at present on the geographical relations of the Lichens of New S. Wales. One observes the absence of *Bacidiæ*, and that the prevailing genera are departures from the New Zealand type.

1. Verrucaria zostra, sp. n. (Tab. VII. fig. 9.) Thallus albo-cinerascens v. cinereus tenuis continuus indeterminatus. Apothecia parva e zonula lata complanata nuda atrofusca cincta, perithecio dimidiatim carbonizato conoideo-prominulo, hymenio hyalino, paraphysibus floccoso-grumosis v. perraro passim parcis inordinatis. Sporæ 5-septatæ hyalinæ oblongæ v. oblongo-fusiformes, long. ·028, crass. ·008 mm. Ad cortices arborum *.

* Quum de excipulo et hymenio &c. loquimur, de eis aguntur qualia in lamina tenuissima apothecii secti conspiciuntur.

2. Verrucaria tichospora, sp. n. (Tab. VII. fig. 5.) Thallus cinerascens tenuissimus lævis continuus. Apothecia matrici imposita prominula thallo subvelata, in statu sicco sæpe collapsa, hymenio linea atra tenui enato, perithecio atro crasso basi expanso, paraphysibus capillaribus ramosis bene discretis. Sporæ in ascis oblongis ovoideæ murali- v. ruderiformi-divisæ hyalinæ v. luteolæ, long. ·032, crass. ·001 mm. Ad cortices arborum.

3. Verrucaria rhaphispora, sp. n. (Tab. VII. fig. 12.) Thallus olivaceo-fuscus tenuis continuus determinatus, gonidiis creberrimis. Apothecia emerso-sessilia globosa matrici imposita, excipulo thallodi in perithecium atrofuscum granosum dimidiatum mutato, poro instructo; hymenium dilute fuscum ex amphithecio ceraceo-lutescenti oriundum, paraphysibus capillaceis discretis. Asci elongato-cylindracei creberrimi ex amphithecio supra et ubique oriundi, ad hymenii centrum directi. Sporæ aciculares rectæ hyalinæ amplius septatæ sexdecim, long. ·065, crassit. ·0025 mm. Ad cortices arborum.

4. Mycoporum sorenocarpum, sp. n. Thallus hypophlœodes badio-fuscus tenuissimus lævis continuus indeterminatus. Apothecia semiimmersa minutissima (diam. 0·1 mm.) pleiopyrenia, hymeniorum innatorum verticibus a tegula communi tectis, tegula convexa papillata pertusa clare fusco-cellulari inter papillas depressa; hymeniis orbicularibus e luteolo pallidis, paraphysibus imperfectis reticulato-diffluxis. Sporæ in ascis globoso-ovoideis oblongæ 3-septatæ, septis sæpius constrictis (cellulis globosis), hyalinæ tandem fuscidulæ, long. ·02, crass. ·007 mm. Spermagonia tubercularia (diam. 0·1 mm.), sterigmatibus simplicibus, spermatiis oblongis rectis, long. ·005, crass. ·002 mm. Ad cortices arborum.

I have seen no specimens of *Mycoporum miserrimum*, Nyl., or of *Verrucaria submiserrima*, Nyl.; with the former the affinity of the New S. Wales Lichen is close. The following notes on *M. elabens* (Schær. Exsicc. no. 232) may be useful:—Hymenia grumosa fuscescentia multa sub eadem tegula, excipulo communi atro tenui enata; *paraphyses nullæ*; sporæ oblongæ utrinque rotundatæ fuscescentes 6–7-loculares, loculis sæpe sensu longitudinali semel aut bis divisis, long. ·022, crass. ·009 mm.

5. Graphis subintricata, sp. n. (Tab. VII. fig. 2.) Thallus cinereo-albus tenuis subgranulosus continuus. Apothecia atra lirellæformia angustissima flexuosa prælonga ramosa sæpe anfractuosa innata nonnihil subdepressa, epithecio perangusto, margine thallodi irregulari panno obsito, excipulo proprio (perithecio) atrofusco laterali infra attenuato; hymenium hyalinum hypothecio tenui incolori matrici imposito enatum, paraphysibus rectis crassiusculis (latit. ·004 mm.) granuloso-inspersis adglutinatis apice non dilatis. Sporæ in ascis elongatis oblongæ utrinque rotundatæ emortuæ fuscæ contractæ, longit. ·02, crass. ·007 mm. Ad cortices arborum.

6. Graphis subtricosa, sp. n. (Tab. VII. fig. 3.) Thallus epiphlœodes albus tenuis

continuus (matrice fissa) indeterminatus, gonidiis creberrimis. Apothecia atra ramosa, ramis brevibus planis e centro radiatim et pedatim divaricatis, apicibus rotundato-obtusis v. sæpius attenuatis, a thallo tenui pallidiore marginatis, excipulo proprio (perithecio) fusco tenui laterali; hymenium hypothecio tenui dilute fusco enatum paraphysibus obscuris grumosis apice fuscis. Sporæ in ascis saccato-clavatis oblongæ utrinque rotundatæ 4-loculares, nonnullæ e linea tenuissima per singula septa percurrens demum dilute fuscæ emortuæ collapsæ fuscæque longit. ·016, crass. ·007 mm. Ad cortices arborum.

Ad *Graphidem tricosam*, Ach., prope accedit. *Graphis tricosa*, Ach., thallus hypophlœodes lutescens a linea atra tenui limitatus; apothecia thallo non marginata; excipulo proprio tenui integro.

7. Graphis aulacothecia, sp. n. (Tab. VII. fig. 4.) Thallus epiphlœodes hypophlœodesque cinereo-albus tenuis minute granulosus continuus nonnihil linea tenui nigricante limitatus. Apothecia lirellæformia prominula subpulverulenta (latit. 0·25 mm.) linearia flexuosa attenuata, disco fusco-atro thallo plus minus cincto, madefacto striatulo, marginibus parallelis atris prominentibus primitus subclausis, excipulo proprio laterali atro crasso, paraphysibus non bene discretis apicibus e granis atris copiosis (ita fit ut epithecium strictur). Sporæ fusiformes incolores demum dilute fuscæ emortuæ collapsæ fuscæque 7-9-septatæ, longit. ·035, crass. ·008 mm. Ad cortices arborum.

8. Graphis elæina, sp. n. (Tab. VII. fig. 11.) Thallus olivaceo-fuscus circularis late expansus continuus granulatus linea atrofusca limitatus, strato corticali incolori. Apothecia lirellæformia ramosa subprominentia, ramis e centro radiatim divaricatis (latit. circa ·4 mm.) apice attenuatis, apicibus thallo tenui pallidiore prominente limbatis et subclausis, epithecio plano atrofusco tenui excipuli margines subexcludente, excipulo proprio integro fusco tenui lateraliter et subtus æqualiter evoluto, paraphysibus inter se conjunctim ramulosis floccosis obscuris. Sporæ in ascis cylindraceis oblongæ utrinque rotundatæ 3-septatæ hyalinæ demum dilute fuscescentes emortuæ collapsæ, longit. ·019, crass. ·007 mm. Ad cortices arborum.

9. Stigmatidium velatum, sp. n. (Tab. VII. fig. 7.) Thallus cinereo-albus tenuis continuus indeterminatus. Apothecia minuta (latit. circiter 0·2 mm.) innata v. plus minus thallo velata, sæpe tecto thallode passim mutato, rotundato-difformia, nonnihil confluentia et deinde pseudo-lirellæformia, excipulo proprio fusco laterali infra attenuato marginata, disco concaviusculo madefacto fusco, hymenio incolori, paraphysibus rectis non bene discretis apice fuscis. Sporæ normaliter 8næ sæpe 1 v. amplior dilute virides varie oblongæ murali- v. ruderi-divisæ, longit. ·032, crass. ·012, mm. Ad cortices arborum.

10. Stigmatidium maculatum, sp. n. (Tab. VII. fig. 1.) Thallus sordide albescens tenuis continuus, madefactus e maculis flavis minutis sparsus, quæ maculæ e gonidiis

usque ad epithallium adtingentibus formantur. Apothecia minuta (latit. circa 0·3 mm.) madefacta thallum æquantia rotundato-difformia v. oblonga, disco atrofusco sæpe thallo pallidiore cincto, margine scabro atro prominente, excipulo proprio aterrimo laterali; hymenium incolor hypothecio tenui carnoso matrici imposito enatum, paraphysibus capillaribus bene discretis. Sporæ in ascis clavatis v. oblongis fusiformes incolores vel demum dilute fuscæ 8-septatæ emortuæ collapsæ, longit. ·04, crass. ·008 mm. Ad cortices arborum.

11. Stigmatidium stictathecium, sp. n. (Tab. VIII. fig. 20.) Thallus cinereo-albus tenuissimus effusus nudus. Apothecia minuta (latit. circa 0·3 mm.) erumpentia, madefacta innata thallum æquantia, rotundato- vel oblongo-difformia et non raro lobata excipulo proprio atro laterali infra attenuato marginata, disco fusco madefacto ex ochraceo fusco minute punctato, quæ puncta ex ascis prominulis formantur; hymenium hypothecio tenui carnoso matrici imposito enatum, paraphysibus rectis (crassit. ·003 mm.) non bene discretis apice non dilatis. Sporæ in ascis clavatis v. oblongis 2–8næ ellipsoideæ v. oblongæ murali-divisæ, seriebus 7–10 transversim loculosæ, loculis non plus quam quatuor in singulis seriebus, longit. ·03, crass. ·014 mm. Ad cortices arborum.

12. Stigmatidium heterogenum, sp. n. (Tab. VIII. fig. 19.) Thallus olivaceo-fuscus tenuissimus minutissime areolatus, gonidiis copiosis. Apothecia minuta thalli verrucis parvis confertis immersa, disco livido plano depresso, margine thallodi pallido pulverulento prominente, excipulo proprio nullo, hymenio dilute fusco matrici imposito, paraphysibus tenuissimis adglutinatis apice non dilatis. Sporæ in ascis clavatis oblongo-ellipsoideæ 3-septatæ hyalinæ, longit. ·017, crass. ·004 mm. Spermagonia tubercularia crebra immiscentia se apotheciis; spermatiis ellipsoideis, longit. ·003, crass. ·002 mm. Ad cortices arborum.

13. Stigmatidium nanocarpum, sp. n. (Tab. VII. fig. 16.) Thallus cinereo-albus tenuissimus continuus indeterminatus, gonidiis glomerulosis. Apothecia minutissima (diam. 0·17 mm.) innata conferta fusca thallo marginata, excipulo proprio nullo, strato subhymeniali atrofusco, hypothecio dilute fusco matrici imposito, paraphysibus discretis subbacilliformibus infra subtilissimo-attenuatis apice fuscis. Sporæ in ascis inflato-clavatis aciculares utrinque acuminatæ subspiraliter curvatæ vel in arcum curvatæ simplices (septis invisibilibus?), longit. ·33, crass. ·002 mm. Ad cortices arborum.

14. Chiodecton stromaticum, sp. n. (Tab. VII. fig. 18.) Thallus tenuis albus v. pulvere stramineo vestitus, strato hypothallino crasso fusco byssino limitatus. Apothecia minuta (diam. circa 0·1 mm. in sectione visa) in verrucis stromaticis applanatis (diam. circa 1·2 mm.) innata, ita in quavis verruca plurimi (centum!) includuntur, pyreno-carpoidea, punctis minutissimus atris madefactis fuscis angulatis; hy-

menia e toro communi enata et ab excipulo proprio laterali tenui sejuncta, paraphysibus discretis subramosis apice non dilatatis. Sporæ in ascis clavatis confertis incolores aciculares sæpissime curvatæ, infra subattenuatæ, 3-septatæ, longit. ·038, crass. ·0025. Ad cortices arborum.

Differs from *C. hypochnoides*, Nyl., in the non-confluent puncta and the dark hypsoid hypothallus; nevertheless it may be only a variety of Nylander's plant. The number of septa of the spores is liable to be overstated unless the spores are examined when free from the ascus. *C. perplexum*, Nyl.!, *C. conspicuum* Nyl.!, *C. rubrocinctum*, Ehrenb.!, *C. sphærale*, Ach.!, *C. farinaceum*, Fée!, have all of them 3-septate spores. It is well, therefore, to note that Fée (*Essai sur les Cryptogames*), in his figures of several species of *Chiodecton*, including *C. sphærale* and *C. farinaceum*, shows the spores with 5–9 cells. The error in the case of the latter two lichens may extend to the other species figured by Fée, as it is found that the spores with only three septa have apparently from five to ten cells when viewed in the ascus, owing to the septa of the spores beneath showing distinctly through the thin hyaline spores in front.

15. Opegrapha megagonidia, sp. n. (Tab. VII. fig. 17.) Thallus sordide cinereoalbus tenuis continuus, gonidiis magnis. Apothecia superficialia conferta lirellæformia elongata (rarius rotundato-difformia v. oblonga) fuscoatra simplicia secta v. flexuosa, epithecio aperto plano v. subconvexo lævi, marginibus non prominentibus medio paululum distentis utrinque subclausis; hymenium fuscum ex excipulo proprio (perithecio) carbonaceo integro crasso enatum, paraphysibus adglutinatis aliquatenus obscuris apice fuscis. Sporæ in ascis clavatis, oblongæ v. lineari-obovatæ, 3-septatæ, emortuæ fuscescentes, longit. ·02, crass. ·006 mm. Ad ligna vetusta v. truncos arborum vetustos.

16. Platygrapha (?) albovestita, sp. n. (Tab. VII. fig. 13.) Thallus hypophlœodes albidus effusus tenuis, matrice fisso-squamosa. Apothecia innata plana vix prominula difformia varie effigurata, primitus tegmine albo vestita, demum in parte denudata nigrescentiaque, hymenio dilute fusco, excipulo thallodi fusco tenui v. nullo, paraphysibus capillaribus adglutinatis apice fuscis. Sporæ in ascis clavatis, fusiformes murali-divisæ, singulæ maximæ (long. ·09, crass. ·012 mm.) vel duæ (tum minores), loculis transversis 16–20, sæpius cellulis mediis semel vel bis divisis, hyalinæ v. luteolæ. Ad cortices arborum.

17. Lecidea (§ Bacidia) entodiaphana, sp. n. (Tab. VIII. fig. 24.) Thallus viridicinerascens tenuissimus obscure areolatus v. continuus effusus, strato corticali diaphano. Apothecia minuta (diam. 0·4 ad 0·7 mm.) adnata, unumquodque et universa fusca, plana, tandem convexa, intus hyalina, excipulo proprio strato gonimico tenui imposito marginata, margine integro crassiusculo in juvenibus tumidulo pallide fusco persistente; hymenium e strato subhymeniali tenui enatum, paraphy-

sibus distinctis in summo apice coloratis vix dilatatis. Sporæ in ascis elongato-clavatis, aciculares, infra attenuatæ, 7- ad 12-septatæ, septis distinctis, long. ·05, crass. ·0035 mm. Ad cortices arborum.

18. ARTHONIA NYMPHÆOIDES, sp. n. (Tab. VII. fig. 15.) Thallus albo-cinerascens v. albescens continuus tenuissimus hypothallo albescente limitatus, gonidiis maximis. Apothecia atrofusca innata matrici imposita rotundato- v. anguloso-difformia, nonnihil lobata, plana, intus dilute fusca (latit. circiter 0·3 ad 0·7 mm.) margine sublevato, hymenii parietibus in excipulo proprium fuscum integrum mutatis, paraphysibus nullis. Asci orbiculari-pyriformes, parietibus crassis. Sporæ nymphæformes incolores, tandem fuscidulæ, non plus 7-cellulares, sæpe curvulæ, cellulis mediis amplioribus, longit. ·034, crassit. ·01 mm. Ad cortices arborum.

19. LECIDEA (fere genus proprium "APHTHOLOMA") CONSPICUA, sp. n. (Tab. VII. fig. 14.) Thallus glauco-cinerascens v. olivaceo-cinerascens tenuis continuus, gonidiis veris magnis glomerulosis. Apothecia minuta (diam. 0·3 ad 0·5 mm.) in tuberculis albis convexis innata fusca v. rufofusca, textura tuberculorum e capillis conglutinatis constituta, capillis in summo discretis erectis; hymenium discoideum e toro (hypothecio) crasso atro in matrice enatum*, paraphysibus brevibus adglutinatis apice non dilatatis. Sporæ in ascis clavatis v. sacciformi-clavatis oblongæ 3-septatæ incolores, longit. ·014, crassit. ·005 mm. Ad cortices arborum.

20. LECIDEA (§ BACIDIA) ENTOCOSMESIS, sp. n. (Tab. VIII. fig. 21.) Thallus sordide cinereo-viridis tenuis (crassit. circa ·15 mm.) continuus lævis v. subpulveratus effusus, strato corticali diaphano. Apothecia sessilia dealbata, matura rosea nonnihil punicea, excipulo proprio crasso dilute colorato e pannis albis formato in strato gonimico tenui imposito marginata, margine obtuso pallide roseo, paraphysibus non bene discretis gracilissimis. Sporæ in ascis elongato-clavatis aciculares, infra attenuatæ, rectæ, circiter 14-septatæ, longit. ·08, crass. ·033 mm. Ad cortices arborum. Similis *Lecanoræ puniceæ.*

21. LECIDEA (§ BUELLIA) METAPHRAGMIA, sp. n. (Tab. VIII. fig. 22.) Thallus griseo-viridis lævis tenuis continuus gonidiorum copiosus. Apothecia atra parvula (diam. 0·5 mm.) adnata conferta plana, demum convexa, sæpe pruinosa, margine tenui concolori prominente, dein obscuro; hymenium fuscum ex excipulo proprio atrofusco partim in strato gonimico albo imposito medio cum matrice coalito enatum, paraphysibus subconglutinatis apice fuscis et tumidis. Sporæ in ascis clavatis fumoso-fuscæ fusiformi-ellipsoideæ in medio sæpissime subconstricto nonnihil subincurvatæ, endosporio sæpe constricto; ita fit, ut se in tri- vel quadriloculares simulate convertant, sed manifesto glycerinæ biloculares sunt, longit. ·018, crassit. ·006 mm. Ad cortices arborum.

* A section distant from the centre of the apothecium would show the torus as a black stratum with the white tubercular mass below it.

Allied to *L. parasema*, Ach., *L. disciformis*, Nyl., *L. myriocarpa*, DC., and *L. triphragmia*, Nyl.

22. LECIDEA (§ BUELLIA) HOMOPHYLIA, sp. n. (Tab. VIII. fig. 23.) Thallus glauco-cinereus tenuis areolato-granulosus, nonnihil ambitu squamuloso-adpressus, linea fusca limitatus, hypothallo atro-fusco. Apothecia sessilia atra passim conferta (diam. 0·5 ad 1 mm.), disco primitus concaviusculo dein plano, margine concolori obtuso prominente persistente sæpe flexuoso; hymenium fuscum ex excipulo fusco-atro partim strato gonimico albo imposito in centro cum hypothallo fusco coalito enatum, paraphysibus adglutinatis grumosis apice fuscis non dilatatis. Sporæ in ascis clavatis, parvulæ, obtuse ovoideæ, fuscæ, 1-septatæ, longit. ·01, crassit. ·006 mm. Ad saxa.

Var. 1. *emphytocarpa*. Thallus glauco-albus. Apothecia innata madefacta areolas superantia. Sporæ obovatæ v. oblongæ nonnihil in medio constrictæ (cellula superiore v. inferiore sæpe ampliore), long. ·018, crass. ·007 mm. Ad saxa.

Var. 2. *amphibola*. Thallus minute areolato-squamulosus. Apothecia in juvenibus thallo tenui marginata, paraphysibus discretis ramosis. Sporæ ellipticæ, longit. ·011, crass. ·005 mm. Ad saxa.

23. LECIDEA (§ DIPLOTOMMA ?) CALLISPORA, sp. n. (Tab. VIII. fig. 26.) Thallus albo-cinerascens v. albidus tenuis effusus, matrice areolato-fissa. Apothecia atra adnata (diam. circiter 0·6 mm.) plana v. subconvexa, excipulo proprio atro ex parte strato gonimico albo imposito in centro cum matrice coalito marginata, margine tenui concolori discum æquante obscuro; hymenium dilute fuscum mucosum passim e gutta hyalina paraphysibus ramosis subtilissimis apice fuscis granosis non dilatatis. Sporæ fuscescentes ellipsoideæ, endosporio symmetrice constricto; ita fit ut se in quadri-loculares eleganter convertant, loculis tubulo in axi sporæ disposito junctis, longit. ·023, crassit. ·011 mm. Ad cortices arborum.

24. LECIDEA (§ CATILLARIA) MELALOMA, sp. n. (Tab. VIII. fig. 29.) Thallus cinereo-albus tenuis continuus, hypothallo nullo. Apothecia atra adnata convexa (diam. fere 1 mm.), intus hyalina, thallo albo imposita, margine concolori persistente, excipulo proprio lamina tenui visu incolori in summo nigrita, textura e lateribus distincte radiatim disposita; hymenium ex excipulo proprio enatum, linea sub-hymeniali fuscescente, paraphysibus non bene discretis, supra cæruleo-nigrescentibus. Sporæ in ascis saccato-clavatis ellipsoideæ biloculares hyalino-inanes, septo distincto, longit. ·016, crassit. ·007 mm. Ad cortices arborum.

Perhaps a variety of *L. phæoloma*, Knight, infrà.

25. LECIDEA (§ CATILLARIA) PHÆOLOMA, sp. n. (Tab. VIII. fig. 31). Thallus viridi-cinerascens tenuis continuus v. obscure reticulatus, hypothallo fusco. Apothecia fusca v. rufofuscescentia plana v. convexa adnata (diam. fere 1·0 mm.) hypo-thallo imposita, margine tenui concolori obscuro persistente, excipulo proprio

leviter colorato in summo fuscescente, textura e lateribus distincte radiatim disposita, strato subhymeniali dilute fuscescente, paraphysibus distinctis. Sporæ in ascis clavatis (parietibus crassis), incolores, ellipsoideæ, biloculares, granulosæ (tum septo sæpe non manifesto) v. hyalino-inanes, longit. ·021, crassit. ·01 mm. Ad cortices arborum.

26. LECIDEA (§ CATILLARIA) TENUILIMBATA, sp. n. (Tab. VIII. fig. 28.) Thallus cinereus tenuis minute granulosus continuus. Apothecia atra plana tandem convexa, margine concolori tenui evanescente; hymenium fuscum, excipulo proprio aterrimo strato thallino albo imposito, paraphysibus adglutinatis apice atris non dilatatis. Sporæ in ascis clavatis, ellipsoideæ, 1-septatæ, hyalinæ, longit. ·017, crass. ·006 mm. Ad saxa arenaria.

27. LECIDEA (§ BIATORA) ENTEROPHÆA, sp. n. (Tab. VIII. fig. 27.) Thallus e cinereo fuscus granulatus linea atra limitatus, granulis minutis albescentibus cum hypothallo fusco-nigro confusis. Apothecia atro-fusca v. atra syncarpa, intus olivacea v. luteo-fusca, immarginata (diam. 0·4 ad 0·8 mm.), excipulo proprio nullo; hypothecium nonnihil linea atra limbatum strato gonimico albo impositum, paraphysibus tenerrimis brevibus (longit. 0·4 mm.) adglutinatis obscuris. Sporæ in in ascis linearibus, uniserialiter 8næ, minutæ, ovoideæ, longit. ·004, crass. ·003 mm. Ad saxa.

28. LECIDEA PORPHYRIA, sp. n. (Tab. IX. fig. 35.) Thallus albus tenuis continuus minutissime granulosus indeterminatus. Apothecia atra v. purpureo-atra adpressa plana (diam. 1 mm.), nonnihil subdifformia, immarginata; excipulum proprium tenue atro-purpureum strato gonimico albo impositum, hymenio purpurascente a latere attenuato, paraphysibus adglutinatis apice atro-purpurascentibus et non dilatatis. Sporæ in ascis elongatis, uniseriales, ovoideæ, simplices, hyalinæ, longit. ·011, crassit. ·006 mm. Ad cortices arborum.

Allied to *Schismatomma*, Flot. & Körb.; but the spores are simple. A section of the apothecium shows the hymenium attenuated towards the margin, as in *L. armenica*, DC.

29. LECIDEA (§ BIATORA) ENTEROXANTHA, sp. n. (Tab. VIII. fig. 30 *c*.) Thallus ferrugineo-fuscescens pulverulentus areolatus indeterminatus. Apothecia innata v. adpressa nigro-fusca madefacta luteo-fusca convexa nonnihil convexo-umbonata, intus lutea, marginata (diam. 0·8 mm.), margine concolori obscuro, excipulo proprio luteolo v. albescente (a lateribus textura radiatim disposita) strato gonimico diluto viridi imposito, strato subhymeniali granifero, paraphysibus crassis adglutinatis, apice luteo-fuscis. Sporæ minutæ ovoideæ simplices hyalinæ in situ tantum non invisæ, long. ·005, crassit. ·003 mm. Ad saxa.

Allied to *L. Kochiana*, Hepp. Perhaps only a variety of the following.

30. LECIDEA (§ BIATORA) DIAPHÆNENTA, sp. n. (Tab. VIII. fig. 30 A.) Thallus murino-

fuscus v. ferrugineo-fuscus, areolis minutis. Apothecia atro-fusca, intus hyalina (diam. ·08 mm.), perraro thallo subcoronata. Ad saxa.

31. LECIDEA MICROSPORA, sp. n. (Tab. IX. fig. 33.) Thallus cinereus tenuis areolatus (sæpe maculis singulis in areolis singulis) indeterminatus. Apothecia atra plana difformia thallum æquantia, margine concolori tenui obscuro; hymenium tenue dilute fuscum excipulo proprio atro impositum, paraphysibus parum crassis adglutinatis apice fuscis. Sporæ minutæ hyalinæ tantum non invisæ, longit. ·004, crassit. ·003 mm. Ad saxa.

32. PERTUSARIA THIOSPODA, sp. n. (Tab. IX. fig. 34.) Thallus e sulphureo glauco-cinereus continuus, gonidiis satis grandibus. Apothecia verrucis thallinis inclusa, verrucis parvis (latit. vix 1 mm. sæpius circa 0·5 mm.) confertis rarius confluentibus convexo- v. hemisphærico-difformibus monopyreniis non sorediosis, ostiolis punctiformibus sæpius papillatis tandem disciformi-apertis carneis, paraphysibus subtilissime capillaribus reticulatim ramosissimis distinctis. Sporæ in ascis oblongis singulæ v. binæ maximæ ellipsoideæ grumosæ lutescentes, normaliter 3-limbatæ (pariete centrali crasso), longit. ·095, crassit. ·038 mm. Ad cortices arborum. Similis fere *Pertusariæ pustulatæ*, Ach., sed hæc habet ostiola plura elevata aggregato-confluentia.

33. PERTUSARIA PETROPHYES, sp. n. (Tab. IX. fig. 32.) Thallus albus detritus, matrice passim nuda. Apothecia verrucis thallinis inclusa, verrucis coacervatis (latit. 2 ad 3 mm.) subgloboso-difformibus basi inflexis pleiopyreniis lacunoso-inæqualibus sæpius albo-farinaceis tunc constanter sterilibus, ostiolis minutis, hymenio incolori, paraphysibus subtilissime capillaribus flocculoso-ramulosis. Sporæ in ascis elongato-cylindraceis late limbatis 8næ uniseriales, nonnullis utrinque truncatis 3-limbatis (pariete centrali crasso), ellipsoideæ, lutescentes, grumosæ, longit. ·085, crass. ·034 mm. Ad saxa. Similis *Pertusariæ communi.*

34. PERTUSARIA LEIOPLACA, Ach. Paraphyses subtilissime capillares ramulosæ flocculosæ. Sporæ in ascis cylindraceis 3-limbatis, grumosæ, pluries limbatæ, longit. ·06, crassit. ·025 mm. Ad cortices arborum.

35. LECANORA ANGULOSA, Ach. Thallus tenuissimus pulverulentus. Apothecia (diam. circiter 0·5 mm. vel minore) margine persistente. Sporæ grumosæ v. nebulosæ, longit. ·016, crassit. ·008 mm. Ad cortices arborum.

36. LECANORA UMBRINA, Ach.

37. LECANORA (?) CORYSTA, sp. n. (Tab. IX. fig. 39.) Thallus cinereus tenuis pulverulentus madefactus dilute chloro-cinerascens continuus indeterminatus, gonidiis copiosis. Apothecia minutissima (diam. 0·2 mm.) dilute fusca difformia pulveracea

plana solitaria v. sæpissime in glomerulos minutos aggregata, ita fit ut 3–5 v. ultra in quovis glomerulo, intus luteola madefacta prominula convexa, margine thallodi sordide albo pulverulento, excipulo proprio nullo; hymenium ex hypothecio simplici v. gonimico (gonidiis sparsis viridibus) thallo imposito enatum, paraphysibus capillaribus (longit. 0·07 mm.) apice non dilatatis. Sporæ in ascis clavatis, ovoideæ, hyalinæ v. luteolæ, longit. 0·008, crassit. 0·005 mm. Ad cortices arborum.

38. Lecanora pallescens, Ach. Apothecia excipulo albo crasso vere thallino (gonidiis inclusis) marginata.

39. Lecanora subpallida, sp. n. (Tab. IX. fig. 36.) Thallus crustaceus tenuis albus v. cinereo-albus continuus minutissime rugoso-granulatus, linea atra limitatus. Apothecia albescentia concava v. plana sessilia sæpe conferta deformia marginata, disco inæquali dilute carneo v. albescente, margine albo crasso tumido flexuoso integro demum extenuato plus minus irregulariter papillato-crenato; hymenium ex hypothecio dilute colorato enatum, excipulo mere thallino albo crasso gonidiis veris sparsis, paraphysibus adglutinatis. Sporæ ellipsoideæ simplices incolores sæpe oleosæ, longit. ·014, crassit. ·006 mm. Ad saxa.

40. Lecanora punicea, Ach. (Tab. IX. fig. 37.) Apothecia excipulo more thallino marginata. Sporæ fusiformi-aciculares subtorquatæ circiter 9-septatæ, longit. ·06, crassit. ·005 mm. Ad cortices arborum.

41. Lecanora atra, Huds. Ad saxa.

42. Lecanora subpiniperda, sp. n. (Tab. IX. fig. 38.) Thallus fusco-cinerascens tenuis subfarinosus effusus, matrice areolato-fissa. Apothecia parva (diam. 0·4 mm.) carnea v. pallido-carnea innata convexa immarginata (in junioribus margine mere thallino obsoleto aut solum non inviso), excipulo proprio nullo; hymenium hyalinum hypothecio hyalino impositum, paraphysibus adglutinatis apice incoloratis. Sporæ in ascis clavatis, oblongæ v. lineari-oblongæ, simplices (nonnihil simulanter 1-septatæ), longit. ·013, crassit. ·004 mm. Ad cortices arborum.

Allied to *L. piniperda*, Körb.; but the apothecia larger and immarginate, or margin obsolete in youth.

43. Physcia melanenta, sp. n. (Tab. IX. fig. 41.) Thallus glauco-cinerascens laciniatus centro laciniato-diffractus, matrici arcte applicatus, laciniis angustis planiusculis adpressis varie lobatis crenatis passim servediosis contiguis apicibus non adscendentibus ad ambitum versus radioso-lobatis, limbo sæpe albo-pulverulento, subtus niger, fibrillis rhizinis concoloribus pannosis. Apothecia nuda scutelliformia adpressa (pseudo-lecideina) aterrima plana parva (diam. circa 1 mm.), excipulo thallodi fusco e gonidiis et granulis composito mox in hypothecium atrum mutato marginata, margine concolori integro tenui persistente; hymenium dilute fuscum

ex hypothecio crasso enatum, paraphysibus capillaribus apice atro-fuscis dilatatis non bene discretis. Sporæ fuscæ ellipsoideæ normaliter 2-loculares, loculis aut discretis aut tubulo in axi sporæ disposito junctis, tum sporæ simulanter 4-loculares, longit. ·017, crassit. ·007. Ad saxa.

There is a variety with larger apothecia, narrow black subhymenial stratum, and broad yellow thalline hypothecium. In other respects similar.

44. Physcia melanoclina, sp. n. (Tab. VII. fig. 10.) Thallus membranaceus stramineo-albus v. glauco-albus arcte matrici toti adglutinatus glomerulosus, glomerulis sorediosis, laciniis lobato-crenatis rugosis confluentibus in centro congestis, subtus nigricantibus v. fuscescentibus extremis partibus incoloratis. Apothecia rubiginosa mox livido-fusca, disco plano tandem subconvexo, margine pallido tenui prominente subintegro, excipulo mere thallino albo; hymenium ex hypothecio fusco-atro enatum, paraphysibus adglutinatis. Sporæ in ascis cylindraceis, fuscæ, fusiformi-ellipsoideæ, 1-septatæ, longit. ·018, crassit. ·006 mm. Ad truncos arborum.

An *P. picta*? *P. picta*, No. 164, Spruce. Lich. Amaz. et And., is closely allied; but the thallus is free from soredia, and the spores 4-locular, the cells united by a central tube. In Montaigne's description of *P. picta* the remarkable dark-coloured hypothecium in contrast with the white thalline excipulum is not noted.

45. Physcia speciosa, var. hypoleuca, Ach.

46. Parmelia perlata, var. sorediifera.

„ Parmelia perlata, var. isidiosa.

47. Parmelia Mougeotii, Schær.

48. Parmelia conspersa, Ach.

49. Parmelia sphærospora, sp. n. (Tab. VII. fig. 6.) Thallus e centro expansus orbiculatus lævis albido-glaucus subtus atrifibrillosus nigrescens, laciniis elongatis, ramusculis convexis subconvolutis apicibus dilatatis applanatis grosse crenatis non adscendentibus. Apothecia subpedicellata (diam. circiter 2·8 mm.) in juniore basi cum fibrillis radiato-ornata, disco badio-rufescente concavo, margine elevato crenato inflexo pallido; hymenium tenue, excipulo thallodi albo, hypothecio crasso hyalino, paraphysibus brevibus adglutinatis. Sporæ in ascis clavatis, minutæ, sphæricæ, sæpissime unam guttam oleosam foventes, diam. 0·007 mm. Similis *P. tiliaceæ*, Ach.

50. Parmelia meizospora, Nyl. Sporæ ellipsoideæ simplices, pariete tenui, hyalinæ, longit. ·017, crassit. ·01 mm. Similis *P. tiliaceæ*, sed sporæ bis terque majores.

51. Ramalina subgeniculata, sp. n. Thallus cæspitosus glauco-albidus, laciniis fastigiatis compressiusculis, madefactis turgidis omnino cavis erectis passim tuberculosis sublacunosis minute foraminatis apice sæpe fructuosis v. parce dichotome ramosis, intus coria fibrillosa, ramis brevibus attenuatis, gonidiis nucleo centrali instructis. Apothecia terminalia subpedicellata, e laciniis turgidis orta, concava, pallida, excipulo mere thallodi marginata, paraphysibus adglutinatis apice non dilatatis. Sporæ oblongæ, nonnullæ incurvatæ, normaliter 1-septatæ, interdum quasi 3-septatæ, hyalinæ, longit. ·013, crassit. ·005 mm. Ad cortices arborum.

52. Ramalina calicaris, L.

DESCRIPTION OF THE PLATES.

Plate VII.

No. 1. *Stigmatidium maculatum*: two spores, × 950.
2. *Graphis subintricata*: (*a*) thin section of apothecium, × 40; (*b*) a spore, × 950.
3. *Graphis subtricosa*: a spore, × 950.
4. *Graphis aulacothecia*: two spores, × 950.
5. *Verrucaria tichospora*: (*a*) three spores, × 950; (*b*) thin section of apothecium, × 40.
6. *Parmelia sphærospora*: ascus and spores, × 950.
7. *Stigmatidium velatum*: (*a*) four apothecia, × 40; (*b*) thin section of three apothecia, × 40; (*c*) three spores, × 950.
8. *Verrucaria sorenocarpa*: (*a*) section of four apothecia, × 40; (*b*) ascus and spores, × 950, the space between the sides of the ascus and the spores is filled with a delicate network.
9. *Verrucaria zostra*: (*a*) two spores, × 950; (*a* section of apothecium. The apothecium rests on the matrix. Thallus seen as a thin white lamina.
10. *Physcia melanoclina*: (*a*) section of apothecium, × 40; (*b*) spore, × 950.
11. *Graphis elæina*: four spores, × 950.
12. *Verrucaria rhaphispora*: ascus and spores, × 950.
13. *Platygrapha albovestita*: spores and asci, × 950.
14. *Lecidea* (*Aphtholoma*) *conspicua*: (*a*) section of apothecium, × 40; (*b*) spores and ascus, × 950.
15. *Arthonia nymphæoides*: spore, × 950.
16. *Stigmatidium nanocarpum*: (*a*) section of apothecium, × 40; (*b*) ascus, spores, and two paraphyses, × 950.
17. *Opegrapha megagonidia*: (*a*) ascus and spores, × 950; (*b*) two gonidia, × 950.
18. *Chiodecton stromaticum*: (*a*) three spores, × 950; (*b*) section of verruca, × 40.

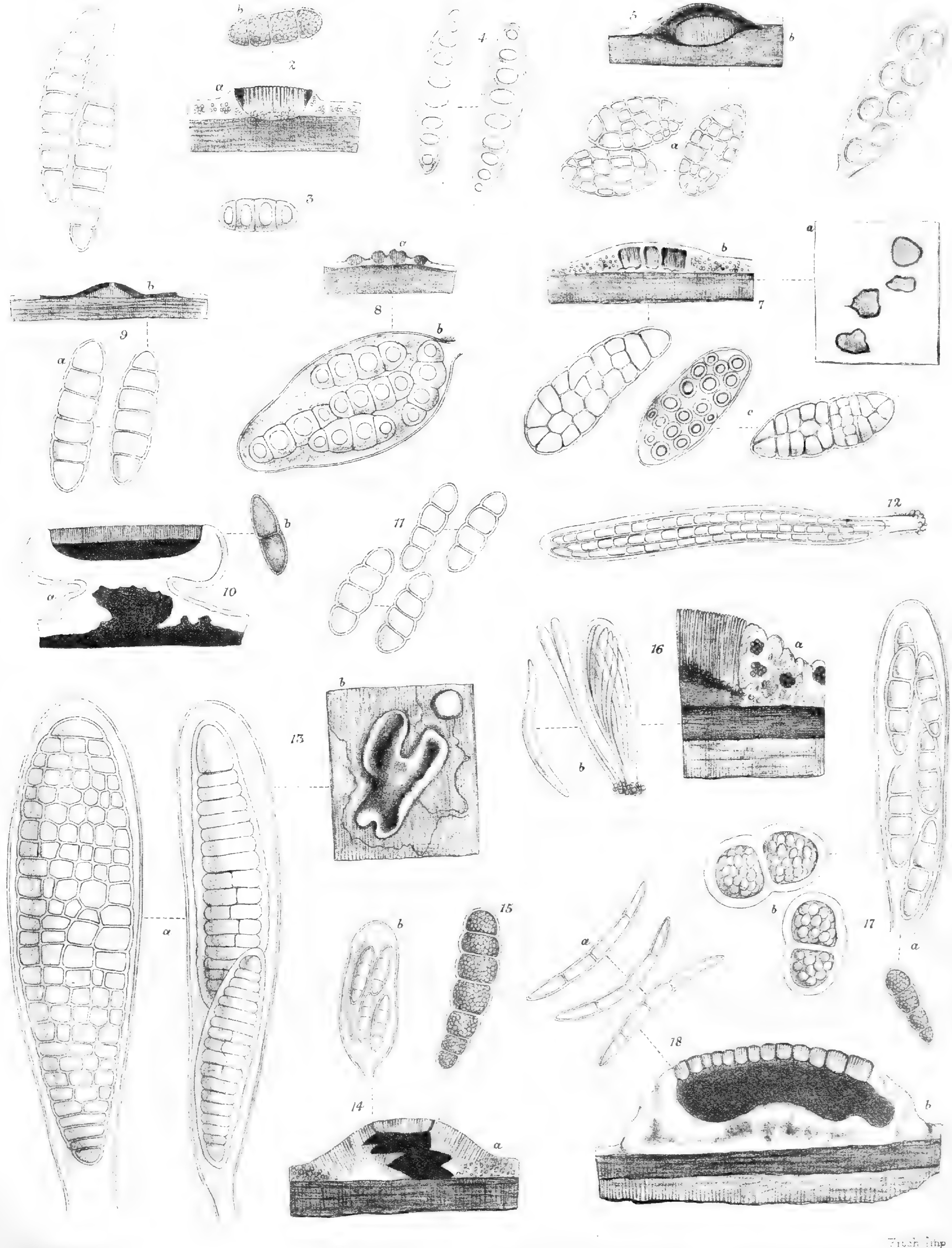
Plate VIII.

19. *Stigmatidium heterogenum*: (*a*) section of apothecium, × 40; (*b*) ascus and spores, × 950.
20. *Stigmatidium stictathecium*: (*a*) two spores, × 950; (*b*) two apothecia, × 40.
21. *Lecidea entocosmesis* (*a*): ascus and spores, × 950; (*b*) section of apothecium, × 40.
22. *Lecidea metaphragmia*: (*a*) four spores, ×950; (*b*) section of apothecium, × 40.

23. *Lecidea homophylia*: (*a*) section of apothecium, showing, 1. hypothallus, 2. thallus, 3. excipulum, × 40; (*b*) spores in ascus, × 950.
24. *Lecidea entodiaphana*: ascus and spores, × 950.
25. *Lecidea homophylia*, var. *emphytocarpa*: ascus and spores, × 950.
26. *Lecidea callispora*: (*a*) ascus and spores, × 950; (*b*) section of apothecium, × 40.
27. *Lecidea enterophæa*: (*a*) ascus and spores, × 950; (*b*) section of four apothecia, × 40.
28. *Lecidea tenuilimbata*: ascus and spores, × 950.
29. *Lecidea meluloma*: (*a*) ascus and spores, × 950; (*b*) section of apothecium, × 40.
30. *Lecidea diaphænenta*): (*a*) two spores, × 950; (*b*) section of apothecium, × 140, showing excipulum, portion of hymenium, and thallodial stratum.
,, *Lecidea enteroxantha*: (*c*) spore, × 950.
31. *Lecidea phæoloma*: (*a*) ascus and spores, × 950; (*b*) two hyaline spores, × 950.

Plate IX.

32. *Pertusaria petrophyes*: (*a*) ascus and spores, × 104; (*b*) spore, × 950.
33. *Lecidea microspora*. (*a*) ascus and spores, × 650; (*b*) section of hypothecium.
34. *Pertusaria thiospoda*: (*a*) ascus and spores, × 320; (*b*) apex of spore, × 950; (*c*) paraphyses, × 320; (*d*) section of apothecium, × 40; gonidium, × 950.
35. *Lecidea porphyria*: (*a*) ascus and spores, × 950; (*b*) section of apothecium, × 40.
36. *Lecanora subpallida*: (*a*) spores and ascus, × 950; (*b*) section of apothecium, × 40.
37. *Lecanora punicea*: (*a*) ascus and spores, × 950.
38. *Lecanora subpiniperda*: (*a*) section of apothecium, × 40; (*b*) ascus and spores, × 950.
39. *Lecanora* (?) *corysta*: (*a*) five spores, × 950; (*b*) gonidium, × 950; (*c*) a cluster of six apothecia, × 40; (*d*) section of a solitary apothecium, × 40; (*e*) section of three apothecia, × 140.
40. *Lecanora angulosa*: ascus and spores, × 950.
41. *Physcia melanenta*: (*a*) five spores, × 950; (*b*) section of apothecium, × 40.



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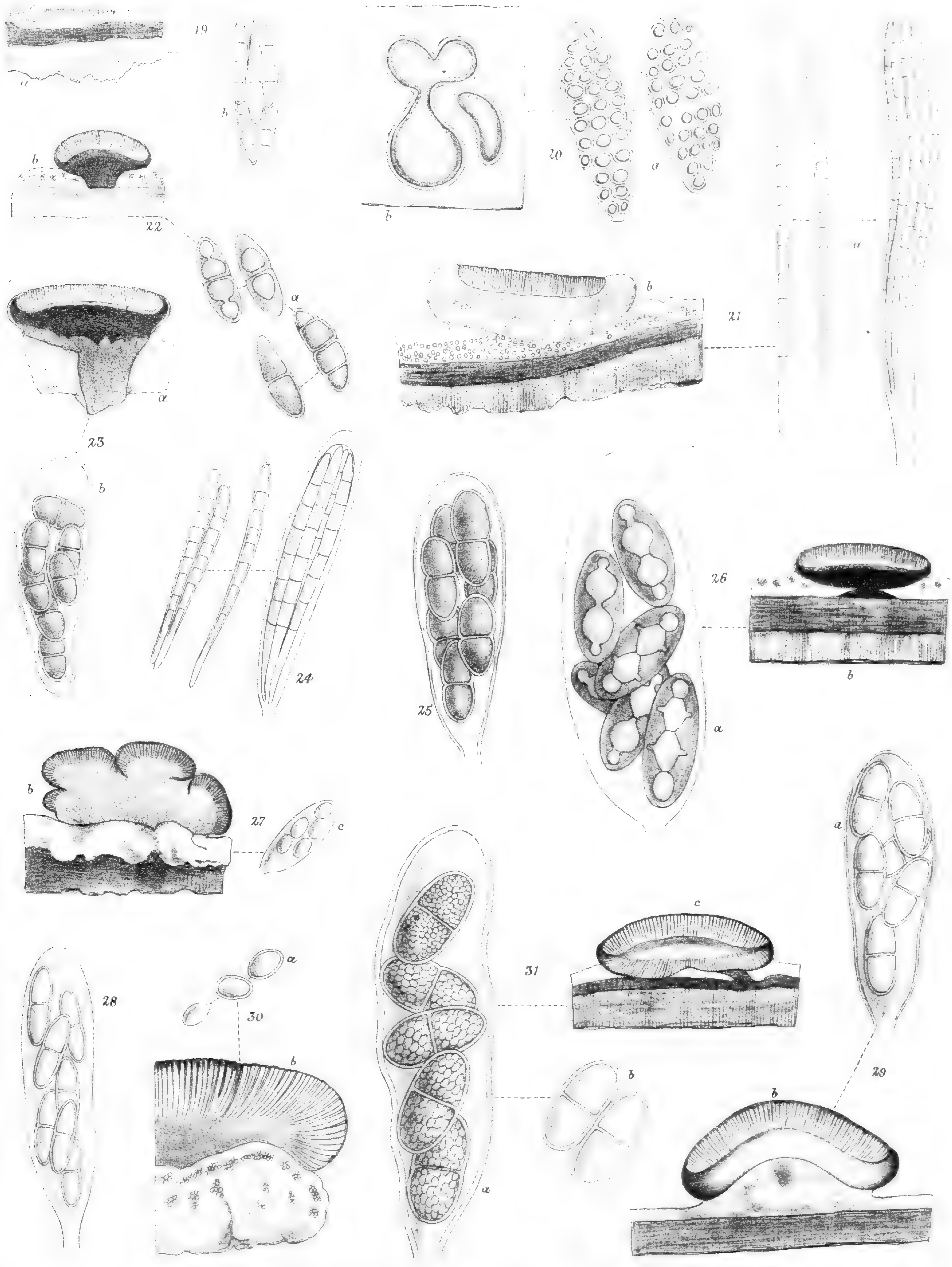
LICHENS OF NEW SOUTH-WALES.



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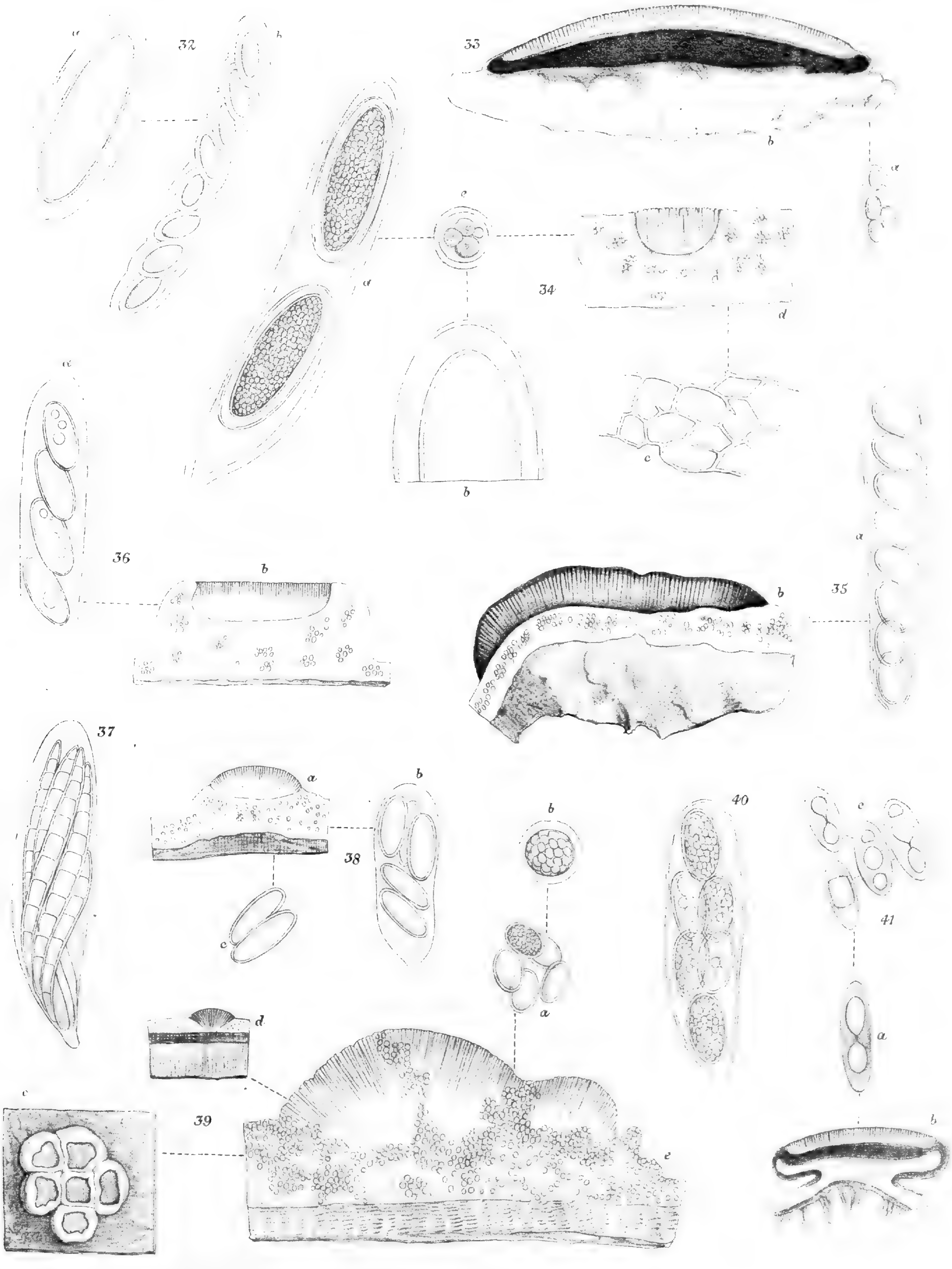

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LICHENS OF NEW SOUTH-WALES.

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Part	V. 1878.	1	4	0	0	18	0
Part	VI. 1879.	1	6	0	0	19	6
Part	VII. 1880.	1	4	0	0	18	0
Part	VIII. 1880.	1	1	0	0	16	0
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Part	II. 1882.	0	5	0	0	3	9

2nd Ser. BOTANY.] [VOL. II. PART 3.

THE

TRANSACTIONS

OF

THE LINNEAN SOCIETY OF LONDON.

LIST OF FUNGI FROM BRISBANE, QUEENSLAND;

WITH

DESCRIPTIONS OF NEW SPECIES.—PART II.

BY

THE REV. M. J. BERKELEY, M.A., F.R.S., F.L.S., & C. E. BROOME, M.A., F.L.S.

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March 1883.

IV. *List of Fungi from Brisbane, Queensland; with Descriptions of New Species.*—Part II. *By the* Rev. M. J. Berkeley, *M.A., F.R.S., F.L.S., and* C. E. Broome, *M.A., F.L.S.*

(Plates X.–XV.)

Read June 15th, 1882.

THIS paper contains an enumeration of the Fungi received from Brisbane since 1878. They consist of 53, for the most part common European species, and dispersed more or less over the whole inhabited world, of a few tropical species common to all tropical regions, and others subtropical, of which an important part are identical with those which occur in the southern parts of Australia. The most interesting are the *Phalloidei*, together with the hypogæous *Hydnangium*. More of their allies would doubtless turn up were attention especially directed to them; but their search, at least that of the Truffles, requires much time and labour, even where an especial interest is attached to them. The occurrence of the Himalayan *Mitremyces viridis* is curious; and there are many other species which, either from considerations of botanical geography or near affinities, are worthy of notice; and we have therefore no scruple in bringing them before the Society.

The present numbers preceding the species, commencing with 92, are in continuation of those of the former paper on the same subject in the 'Transactions,' New Ser., Bot. vol. i. pp. 399–408.

92. Agaricus (§ Amanita) vaginatus, Bull. Brisbane (*F. M. Bailey*, no. 373).

93. Agaricus (§ Lepiota) dolichaulos, Berk. & Broome, "Fungi of Ceylon," Linn. Soc. Journ. vol. xi. p. 496. Brisbane (*F. M. Bailey*, no. 293).

94. Agaricus (§ Lepiota) cepæstipes, Sow. Brisbane (*F. M. Bailey*, no. 160).

95. Agaricus (§ Lepiota) aspratus, Berk. in Lond. Journ. of Botany, i. p. 97, 1849.

The pileus of this species is clothed with beautiful stellate hairs. Brisbane (*F. M. Bailey*, no. 161).

96. Agaricus (§ Armillaria) melleus, Vahl. Brisbane (*F. M. Bailey*, no. 207).

97. Agaricus (§ Tricholoma) civilis, Fr.

The specimen agrees generally with Fries's characters; and without notes we cannot distinguish it from that species. Brisbane (*F. M. Bailey*, no. 232).

98. Agaricus (§ Clitocybe) rheicolor, Berk. in Ann. Nat. Hist. ser. i. vol. iii. p. 376. Brisbane (*F. M. Bailey*, no. 398).

99. Agaricus (§ Collybia) coagulatus, Berk. & Broome. Cremoricolor, pileo hæmisphærico, rugoso-striato, lamellis paucis, stipite gracili cartilagineo luteo torto inæquali basi subdilatata.

Pileus in the dry state about $\frac{3}{4}$ inch across, 4 lines deep, hemispherical, striate, yellow-horn-colour, glabrous; stem about 2 inches high, of the same colour as the pileus, glabrous, $1\frac{1}{2}$ line thick. Brisbane (*F. M. Bailey*, no. 256).

100. AGARICUS (§ PLEUROTUS) SORDULENTUS, Berk. & Broome. Pileo orbiculari subreniformi sordide albo primum hirsutulo dein glabrescente, stipite obsoleto vel vertice affixo, lamellis albis ventricosis.

Pileus $\frac{3}{4}$ to $1\frac{1}{4}$ inch across, margin incurved; at first resembling *Agaricus mollis*, but in reality very different, both in the absence of a stem and in the clothing of the pileus and colour of the gills. The spores were either in bad condition or uncertain in their appearance. Brisbane (*F. M. Bailey*, no. 292).

101. AGARICUS (§ PLEUROTUS) SEMILIBER, Berk. & Broome. Candidus, pileo semiadhærente sericeo, lamellis tenuibus decolorantibus.

This species is allied to *A. semisupinus*, Berk. & Broome, but without the central column to which the gills are attached. The pileus is woolly, pallid yellow, when dry attached by a very short lateral stem; besides the coarse woolly clothing of the pileus, it is beset with slender, erect, hyaline hairs; gills moderately close, rather broad and rough, with granules especially at their edge; spores ovate, smooth, about 0·0003 inch long. Brisbane (*F. M. Bailey*, no. 159).

102. AGARICUS (§ FLAMMULA) SAPINEUS, Fr. Brisbane (*F. M. Bailey*, nos. 201, 254, 297).

103. AGARICUS (§ FLAMMULA) BAILEYI, Berk. & Broome, n. sp. Aurantiacus, pileo primum e campanulato hemisphærico demum expanso lanato, adulto particulis furfuraceis sparso, margine inflexo; stipite brevi æquali primum floccoso; lamellis distantibus dente adnatis.

Pileus at first conical and ochraceo-rufous, then hemispherical and dark brown sprinkled over with reddish-yellow scales and expanded, the margin incurved; gills rather distant, branched halfway up, same colour as the pileus; stem curved, equal, at length dark brown, at first ochraceous, sprinkled, like the pileus, with reddish furfuraceous scales. Pileus from two lines when young to $\frac{1}{2}$ inch across; stem 5 to 7 lines high. Growing in a cæspitose manner on rotten wood. Brisbane (*F. M. Bailey*, no. 189).

104. AGARICUS (§ GALERA) PEROXYDATUS, Berk. in Lond. Journ. of Botany, 1843, p. 511. Brisbane (*F. M. Bailey* no. 179).

105. AGARICUS (§ CREPIDOTUS) MOLLIS, Schœff. Brisbane (*F. M. Bailey*, no. 213).

106. AGARICUS (§ PSALLIOTA) VERSIPES, Berk. & Broome. Pileo amplissimo medio depresso lento albo, stipite floccoso farcto, basi attenuata, annulo amplo; lamellis ex albo salmonicoloribus liberis basi fasciculatis.

At the roots of bamboos in the Botanic Garden, Brisbane. Pileus 5 to 8 inches across, white, smooth, like chamois leather; gills at first white, changing to pale salmon-colour, fasciculate at the base (*F. M. Bailey*), a character not very visible in the dried specimen; spores pale, 0·0003 to 0·0004 inch across. A single individual occurred in the same locality which does not agree in the floccose contents of the stem, which is very laccate at the base. Mr. Bailey, however, did not consider it distinct; he also says that the large form has a strong scent of garlic when drying. "Stem (when fresh) 6 inches high, $1\frac{1}{2}$ thick, somewhat hollow but not piped; gills not attached to the stem, and formed in bundles, like the stamens of an orange."—*F. M. B.* Brisbane (*F. M. Bailey*, no. 230).

107. AGARICUS (§ PSATHYRELLA) DISSEMINATUS, Fr. Brisbane (*F. M. Bailey*, no. 237).

108. AGARICUS (§ NAUCORIA) MELINOIDES, Bull. Brisbane (*F. M. Bailey*. no. 233).

109. HYGROPHORUS PORPHYRIUS, Berk. & Broome, n. sp. Pileo campanulato obtuso carnoso viscidulo; stipite æquali concolori obtuso; lamellis adnexis albis.

$1\frac{1}{4}$ inch wide, $1\frac{1}{2}$ high, stem $1\frac{1}{2}$ high $\frac{1}{3}$ thick. In drying, the sides of the pileus contract so as to make the species appear strongly umbonate. Amongst grass. Brisbane (*F. M. Bailey*, no. 170). "Top of pileus purple, gills white, stipes mottled."—*F. M. B.* In Mr. Bailey's drawing the whole plant is represented of a pale cinereous purple colour, the stem as swollen in the middle (the latter is described as "mottled"), the pileus of a conical shape.

110. LENTINUS CATERVARIUS, Berk. & Broome, n. sp. Cæspitosus aureus, pileo convexo explanato glabro; stipite cylindrico crasso subæquali, lamellis angustis decurrentibus hic illic erosis.

Pileus $2\frac{1}{2}$ inches across; stem $1\frac{1}{2}$ to 2 inches high, 5 lines to $\frac{1}{2}$ inch thick. Mr. Bailey says this species grows in large masses amongst grass; and his sketch represents the pileus as very irregular in form, much curled and wrinkled. Brisbane (*F. M. Bailey*, no. 253).

111. LENTINUS EXASPERATUS, Berk. & Broome. (Plate X. figs. 1 & 1^a.) Pileo explanato umbonato, velato, verrucis rigidis exasperato, ferrugineo-pulverulento, stipite deorsum incrassato lamellis liberis hic illic erosis.

Pileus $\frac{1}{2}$ inch across; stem about 5 lines high, 3 lines thick at base. There is no *Lentinus* in the Kew herbarium which agrees with this species; *L. durus* comes nearest to it. It is remarkable for the numerous rigid warts covering the pileus. Brisbane (*F. M. Bailey*, no. 262).

112. LENTINUS PUNCTATICEPS, Berk. & Broome, n. sp. (Plate X. figs. 2–7.) Pileo laterali, punctato-hispido, stipite cum lamellis decurrentibus luteis, acie acutis hic illic erosis.

The clothing contracts so as to leave small, punctate cavities, presenting a sponge-like appearance. Brisbane (*F. M. Bailey*, no. 283).

113. LENTINUS EUGRAMMUS, Mont. Cuba Crypt. 414, t. xvii. f. 2. Brisbane (*F. M. Bailey*, no. 183).

114. PANUS INCANDESCENS, Berk. & Broome, n. sp. (Plate X. figs. 8–10^a.) Pileo umbilicato quandoque infundibuliformi glabro minute virgato margine involuto, lamellis tenuibus longissime descendentibus, stipite sursum incrassato deorsum cylindrico striato.

Apparently on the soil, but possibly springing from buried wood, forming large, often confluent masses. Pileus 3 inches across; stem $1\frac{1}{2}$ inch high, $\frac{1}{3}$ inch thick above, $\frac{1}{4}$ below; gills very decurrent, forming mere lines (fig. 10^a). Very luminous at night, like some other Australian Agaricini. Brisbane (*F. M. Bailey*, no. 26).

115. Panus suborbicularis, Berk. & Broome, n. sp. Pileo suborbiculari crenato albo subtiliter tomentoso, stipite obsoleto, lamellis ad basin tomentosis decurrentibus, acie integris.

Pileus $2\frac{1}{2}$ inches wide, subimbricate, 2 inches long. The gills are close and rather wide, and curled up in drying. On old whale-bones. Brisbane (*F. M. Bailey*, no. 291).

116. Panus viscidulus, Berk. & Broome, n. sp. Pileo strato superiore gelatinoso flabelliformi pallide ardosiaco viscidulo, margine inflexo; stipite brevi laterali villoso e basi spongiosa oriundo; lamellis decurrentibus angustis albis.

Pileus $1\frac{1}{2}$ to $1\frac{3}{4}$ inch across; stem very short, villous, springing from a shaggy base; gills very decurrent running down the short stem. Mr. Bailey describes the pileus as "dull slate-coloured, somewhat clammy, gills white." The above description is drawn up from the plant when fresh; the gills and pileus become of a dark brown in drying, the stem and villous base of a dirty or yellowish white. On decaying bark. Brisbane (*F. M. Bailey*, no. 312).

117. Xerotus proximus, Berk. & Broome, n. sp. (Plate X. figs. 11–13.) Albus, pileo suborbiculari subtiliter pulverulento, stipite laterali vel subcentrali; lamellis decurrentibus, interstitiis venosis.

This species is white when fresh, but turns a yellowish fulvous or black in parts when washed with spirit of wine; pileus thin, from $\frac{1}{2}$ inch to $1\frac{1}{2}$ inch wide, $\frac{1}{2}$ to $\frac{3}{4}$ inch long; hymenium turning black from the spirit; gills rather narrow, distant, interstices marked with prominent veins branching off from the lamellæ; stem excentric, about $\frac{1}{2}$ an inch long, tomentose, of the same colour with the pileus, equal. Brisbane (*F. M. Bailey*, no. 187).

118. Xerotus Bertierii, Mont. Fl. Chili. vii. 353. Brisbane (*F. M. Bailey*, no. 410).

119. Xerotus Rawakensis, Fr. Ag. Pers. Brisbane (*F. M. Bailey*, no. 131).

This differs slightly from Persoon's characters, but not sufficiently to constitute a new species.

120. Xerotus albidus, Berk. & Broome, n. sp. (Plate X. figs. 14, 15.) Albidus, pileo reniformi glabro subhygrophano, ipso margine striato; stipite laterali glabro; lamellis paucis, interstitiis lævibus attingentibus; siccus fulvus.

Pileus from $\frac{3}{4}$ to 1 inch wide by $\frac{1}{2}$ to $\frac{3}{4}$ inch long, thin, clothed with short fulvous (when dry) tomentum, striate, especially towards the margin, from the contraction of the thin substance between the gills; hymenium of the same colour as the pileus, gills distant, but repeatedly branched about halfway from the stem, moderately wide, interstices quite smooth; stem lateral, brown, slightly velvety, thicker downwards, about $\frac{1}{4}$ inch long. Brisbane (*F. M. Bailey*, no. 182).

121. Xerotus lateritius, Berk. & Cooke in Ann. Nat. Hist. ser. ii. vol. xii. p. 428. Brisbane (*F. M. Bailey*, no. 339).

122. Lenzites Berkeleyi, Lév. in Ann. Scien. Natur. 1846, ser. iii. t. v. p. 122. (*Dædalea betulina velutina*, Berk. in Ann. Nat. Hist. ser. i. vol. iii. p. 381.)

Mr. Bailey remarks that "when fresh the upper side of the pileus is rather pink, the gills white." Brisbane (*F. M. Bailey*, no. 285).

123. Lenzites Faventinus, Caldesi, Erb. critt. Ital. no. 89. Brisbane (*F. M. Bailey*, nos. 202–212).

124. Lenzites striata, Fr. Brisbane (*F. M. Bailey*, no. 334).

125. Strobilomyces nigricans, Berk. in Lond. Journ. of Bot. 1852, p. 139.

"The colour changes but little in drying; the hymenium is very dark, almost black, the pileus is very dark and scaly, the pores close to the stem."—*F. M. B.* Brisbane (*F. M. Bailey*, no. 260.)

126. Boletus hædinus, Berk. & Broome, n. sp. Pileo convexo crasso alutaceo primitus subtomentoso, stipite basin versus incrassato, sursum reticulato concolori, poris pallidis.

Pileus 3 inches across; stem 2 inches high, nearly 1 inch thick at the base. Brisbane (*F. M. Bailey*, no. 231).

127. Polyporus (§ Mesopus) rugosus, Nees. Gippsland, Victoria.—*Miss F. M. Campbell*. Brisbane (*F. M. Bailey*, no. 403, 43).

128. Polyporus (§ Mesopus) rufescens, Fr. Gippsland, Victoria.—*Miss F. M. Campbell*, no. 47 (*F. M. Bailey*, no. 403, 47).

129. Polyporus (§ Mesopus) arcularius, Fr. Brisbane (*F. M. Bailey*, no. 152).

130. Polyporus (§ Mesopus) tomentosus, Fr. Gippsland, Victoria, *Miss F. M. Campbell*, nos. 3, 21 (*F. M. Bailey*, no. 347). No. 21 is in a different state to no. 3, the surface being blackish and leathery, and resembles a *Xylaria*.

131. Polyporus (§ Pleuropus) luteus, Nees, N. Act. N. C. xiii. 16, t. 4.

A plant apparently belonging to this species occurred in a viviparous condition, or else forming a habitat to some parasitic *Polyporus*. It came without any number. Brisbane (*F. M. Bailey*, no. 174).

132. Polyporus (§ Pleuropus) dictyopus, Mont. in Ann. des Sci. Nat. 1835, t. iii. p. 349. Brisbane (*F. M. Bailey*, no. 168.)

Our specimens are from $\frac{1}{2}$ to $\frac{3}{4}$ inch across, the pileus concentrically zoned and rugose, with a few fine lines radiating from the stem to the margin, especially in the smaller specimen, about 2 lines thick; the pores extend up to the margin, which is rather obtuse. The stem is reticulato-rugose; particularly at the extreme base.

133. Polyporus (§ Pleuropus) melanopus, Fr. Brisbane (*F. M. Bailey*, no. 272).

134. Polyporus (Pleuropus) dorcadideus, Berk. & Broome, n. sp. (Plate X. figs. 16–16^a.) Pileo flabelliformi lobato umbrino pruinoso-velutino venoso, stipite brevi, poris mediis hexagonis, dissepimentis (in sicco) tenuiter laceratis.

Pileus $3\frac{1}{2}$ inches wide, 3 long; flabelliform, of a rich umber or fawn-colour (hence the specific name), clothed with very short velvety down, which gives it a pulverulent appearance, margin very thin, slightly incurved; hymenium much paler, in external appearance resembling *Polyporus russiceps*, Berk. & Broome; but the hymenium is very different, the pores being angular, and about a line across, and laterally compressed. The stem is about 1 inch long by $\frac{1}{2}$ inch thick, and tomentose. Brisbane, *F. M. Bailey*, no. 374.

135. Polyporus (§ Pleuropus) Guilfoylei, Berk. & Broome, n. sp. Pileo spathulato laterali subtiliter pulverulento, stipite e pileo producto nigro cartilagineo, hymenio in stipitem descendente pallido, poris punctiformibus $\frac{1}{120}$ unciæ in diametro.

The pileus in the Brisbane plant is smooth, at least in the larger specimen, and shines with a lustre like that of crockery, of a palish yellow colour, and thin at the margin. The pores are round, and run up quite to the edge of the pileus and halfway down the stem, which is black from thence to the base; the pores terminate abruptly, being about a line in length, and quite distinct from the stem; the hymenium is of the same colour as the pileus, but a trifle darker; the pileus is from $\frac{3}{4}$ to $1\frac{3}{4}$ inch wide, and from $\frac{3}{4}$ to $1\frac{1}{2}$ inch long, exclusive of the stem, which is $\frac{3}{4}$ to 1 inch in length. Logan River, Brisbane (*F. M. Bailey*, no. 211).

136. Polyporus (§ Pleuropus) grammocephalus, Berk. in Lond. Journ. Bot. 1842, p. 148. Brisbane (*F. M. Bailey*, no. 176).

137. Polyporus (§ Pleuropus) nephridius, Berk. in Hook. Journ. of Bot. vol. viii. p. 195. Brisbane (*F. M. Bailey*, no. 298).

138. Polyporus (§ Pleuropus) vinosus, Berk. in Ann. Nat. Hist. ser ii. vol. ix. p. 195.

This species appears to be very closely related to *P. nephridius*, Berk. Brisbane (*F. M. Bailey*, no. 325).

139. Polyporus (§ Inodermei) vellereus, Berk. (Plate X. figs. 17–18.) Lond. Journ. Bot. 1842, vol. i. p. 455. Brisbane (*F. M. Bailey*, no. 355).

140. Polyporus (§ Anodermei ?) ochroflavus, Cooke, MSS. in Herb. Kew.

Mr. Bailey's plant resembles no. 340, *P. corrivalis*, in some respects, but it is much thicker and firmer. Brisbane (*F. M. Bailey*, no. 341).

141. Polyporus (§ Anodermei) portentosus, Berk. in Lond. Journ. Bot. 1844, vol. iii. p. 188.

This plant comes near to *P. ochroflavus*, Cooke in Kew Herb. Brisbane (*F. M. Bailey*, no. 385).

142. Polyporus (§ Anodermei) funalis, Fr. Port Douglas, Australia, *Rev. J. E. T. Wood* (*F. M. Bailey*, no. 376).

143. Polyporus (§ Anodermei) corrivalis, Berk. in Linn. Soc. Journ. vol. xiii. p. 162. Brisbane (*F. M. Bailey*, no. 267).

144. Polyporus (§ Anodermei) zonalis, Berk. in Lond. Journ. of Bot. 1847, p. 504. Brisbane (*F. M. Bailey*, no. 193).

145. Polyporus (§ Anodermei) pelliculosus, Berk. in Lond. Journ. of Bot. vii. p. 575 (1848).

"This species is dark red in colour, juicy, and grows close to the wood."—*F. M. B.*

It is like *P. spissus*, Fr., in habit, but has larger pores, and the septa are less regular. Brisbane (*F. M. Bailey*, no. 318).

146. Polyporus (§ Anodermei) compressus, Berk. in Lond. Journ. of Bot. 1845, p. 53. Brisbane (*F. M. Bailey*, nos. 136, 137).

147. Polyporus (§ Placodermei) ochroleucus, Berk. in Lond. Journ. of Bot. 1845, p. 53. Brisbane (*F. M. Bailey*, no. 138).

148. Polyporus (§ Placodermei) lineato-scaber, Berk. & Broome, n. sp. (Plate XI. figs. 1, 1[a], & 1[b]). Pileo dimidiato postice descendente rigido brunneo, margine pallido, frequenter zonato, lineato-radiato scabroso; hymenio rhabarbarino, poris punctiformibus, dissepimentis obtusis.

Pileus 4 inches wide, $2\frac{1}{4}$ long; pores $\frac{1}{84}$ inch across, including the dissepiments, rigid, rich red-brown, repeatedly zoned, margin pale, rough, with radiating lines of short tufted flocci; hymenium and substance rhubarb-coloured. A most beautiful species, far handsomer than *P. gilvus* (*Ravenel*, no. 113), to which species it approaches, differing, however, in its more strongly marked zones, rougher pileus, deeper colour, and in its pores, which are half as large again. North Queensland, *Rev. J. E. T. Wood* (*F. M. Bailey*, no. 357).

149. Polyporus (Placodermei) testudo, Berk., n. sp. (Plate X. figs. 19 & 19[a].) Pileo imbricato rigido pulverulento griseo hic illic obscure striato scabridoque; hymenio griseo, margine incurvo puberulo, poris minutis irregularibus angulatis, dissepimentis tenuibus.

Pileus rigid, imbricated, brownish grey, pulverulent, uneven, here and there marked with indistinct striæ, slightly incurved at the paler and pulverulent margin, $\frac{1}{3}$ to $\frac{1}{2}$ inch wide by $\frac{1}{2}$ inch long. Pores minute, scarcely visible to the naked eye, angular, with thin dissepiments (fig. 19[a]). The hymenium is more distinctly grey than the upper surface of the pileus. This species is allied to *P. plebeius*, Berk., and possibly a form of it (Fl. of New Zealand, p. 179). Brisbane (*F. M. Bailey*, no. 323).

150. Polyporus (§Anodermei) gilvus, Fr. Brisbane (*F. M. Bailey*, no. 333).

151. Polyporus (§ Inodermei) versicolor, Fr.
A thick form. Brisbane (*F. M. Bailey*, no. 226).

152. Polyporus (§ Inodermei) gallopavonis, Berk. & Broome, n. sp. Imbricatus; pileo tenui flabelliformi, repetiter zonato, intus pallido, antice umbrino, pulverulento, ipso margine subtiliter tomentoso obscuriore; hymenio concavo, ochroleuco, prope marginem sulcato; poris parvis irregularibus, 0·002–0·014 unc. diam.

Pileus about $2\frac{1}{2}$ inches long by $1\frac{1}{2}$ wide, of a dull ochre, with numerous narrow zones of a greyish ochre tint, especially towards the margin, which is thin and minutely tomentose, as is also the upper surface. Pores minute, of the same colour as the pileus, more cinereous towards the hinder parts, irregular, varying much in size, angular. Brisbane (*F. M. Bailey*, no. 139).

153. POLYPORUS (§ INODERMEI) CONTRARIUS, Berk. & Curtis. (Plate XI. figs. 2–4.) Pileo applanato rubiginoso; hymenio albo, poris minutis punctiformibus acie obtusis, contextu albo.

On logs, Cuba, no. 946. About 2 inches wide. There is a specimen from Cuba, older and discoloured *, the hymenium no longer white, but grey, the pores of which are larger, no. 938. Both in June. Brisbane (*F. M. Bailey*, no. 322).

154. POLYPORUS (§ INODERMEI) CINNABARINUS, Fr.

Very fine specimens of this species were sent without any number. The separation of specimens from *P. sanguineus* requires great caution. Brisbane (*F. M. Bailey*).

155. POLYPORUS (§ INODERMEI) LUTEO-OLIVACEUS, Berk. & Broome, var. TENUIS.

This plant appears to be merely a thin form of the above species, no. 30. Brisbane (*F. M. Bailey*, no. 362).

156. POLYPORUS (§ INODERMEI) VENUSTUS, Berk. in Lond. Journ. of Botany, 1845, p. 55. On the cracks of old logs. Brisbane (*F. M. Bailey*, nos. 243, 259).

157. POLYPORUS (§ INODERMEI) PERADENYIÆ, Berk. & Broome in Linn. Soc. Journ. xiv. p. 51. Brisbane (*F. M. Bailey*, nos. 271, 302).

158. POLYPORUS (INODERMEI) FLORIDANUS, Berk. in Ann. Nat. Hist. ser. 1, vol. x. p. 376. On Fungi in the British Museum. Brisbane (*F. M. Bailey*, no. 248).

159. POLYPORUS (§ INODERMEI) ELONGATUS, Berk., var. STIPITATUS, Berk. & Broome. Brisbane (*F. M. Bailey*, no. 360).

160. POLYPORUS (§ INODERMEI) RADIATUS, Fr. Brisbane (*F. M. Bailey*, no. 306).

161. POLYPORUS (§ INODERMEI) LILACINO-GILVUS, Berk. in Ann. Nat. Hist. ser. 1, vol. iii. p. 324. Brisbane (*F. M. Bailey*, no. 206).

162. POLYPORUS (§ INODERMEI) ANEBUS, Berk. in Lond. Journ. of Botany, 1847, p. 504.

This species resembles somewhat *P. micromegas*, Mont., as to the pileus, but it has smaller pores. Brisbane (*F. M. Bailey*, no. 324).

163. POLYPORUS (§ RESUPINATUS) FERRUGINOSUS, Fr. Brisbane (*F. M. Bailey*, no. 209).

164. POLYPORUS (§ RESUPINATUS) MEDULLA-PANIS, Fr. Brisbane (*F. M. Bailey*, no. 172).

165. POLYPORUS (§ RESUPINATUS) ERIOPHORUS, Berk. & Broome, n. sp. (Plate XI. figs. 5 & 6.) Candidus, adnatus, totus gossypinus, margine leviter reflexo, poris irregularibus mediis, acie obtusis.

On pine sticks. Often orbicular, and becoming confluent; when perfectly resupinate the margin is byssoid: it resembles a good deal some forms of *Merulius corium*, but seems to be a true *Polyporus*. Each patch measures, when not confluent, from ½ to 1 inch across. Brisbane (*F. M. Bailey*), no. 419).

166. TRAMETES OCCIDENTALIS, Fr., *Polyporus*, Berk. in Ann. Nat. Hist. ser. i. vol. iii. p. 393. (*Trametes occidentalis*, Spruce, no. 29.) Brisbane (*F. M. Bailey*, no. 286).

* "Qui color albus erat, nunc est contrarius albo."

166 bis. Trametes rigida, Berk. & Mont. in Ann. Sci. Nat. 1849, t. xi. p. 240, 37, var. tenuis.

A thin, nearly resupinate form. Brisbane (*F. M. Bailey*, no. 311).

167. Trametes picta, Berk. (*Trametes Mülleri*, var., Berk. in Linn. Soc. Journ. vol. x. p. 320.) Brisbane (*F. M. Bailey*, nos. 140 and 294).

168. Trametes umbrina, Currey, in Linn. Trans. ser. ii. Bot. vol. i. p. 124. Brisbane (*F. M. Bailey*, no. 190).

169. Trametes versatilis, Berk. in Lond. Journ. of Botany, 1842, p. 150. Brisbane (*F. M. Bailey*, no. 227).

170. Dædalea aspera, Kl. in Linnæa, 1833, viii. p. 480. Brisbane (*F. M. Bailey*, no. 165).

171. Dædalea incompta, Berk. MSS. (Plate XII. figs. 1, 2.) Pileo pallido, maculis sordide brunneis variegato, fisso, duro, rugoso, zonato, margine obtuso; hymenio minute sinuoso, lignicolori, poris postice descendentibus.

Pileus imbricated, 2 inches wide, $1\frac{1}{2}$ long, of a pallid tint, variegated with dirty brown stains, cracked (perhaps in drying), rough and zoned. The hymenium is wood-coloured, composed of minute and irregular sinuosities, which run down the wood on which it grows, and there form sistotrema-like teeth; dissepiments thin, rigid, the edges even, about $\frac{1}{2}$ a line to a line in depth; substance hard, much paler than the hymenium, from 1 to $1\frac{1}{2}$ line thick. Port Douglas, *Rev. J. E. Tenison Woods* (*F.M. Bailey*, no. 377).

172. Dædalea sanguinea, Fr.

The pores measure about $\frac{1}{100}$ inch across. A resupinate form of this species was also sent without a number. Brisbane (*F. M. Bailey*, no. 361). No. 369 seems to be the same thing in a more advanced state.

173. Dædalea scalaris, Berk. & Broome, n. sp. (Plate XI. figs. 7–9.) Albus, pileis imbricatis crassis sursum quasi dealbatis, poris ex rotundis varie sinuosis acie obtusiusculis, contextu molli suberoso candido.

Pileus 3 inches long, imbricated, from $\frac{3}{4}$ to 1 inch thick; pores about 1 line deep, dædalioid except at the extreme margin, where they are subrotund but irregular. It has very much the habit of *Trametes gibbosa*; but the hymenium is very different; it differs also in the upper surface, which looks as if it had been whitewashed. Brisbane (*F. M. Bailey*, no. 429).

174. Hexagonia crinigera, Fr.

The specimen was sent under this name; but Fries describes his plant as not zoned, whereas the present plant is distinctly zoned; nor is the attachment the same exactly, neither is the pileus "rotundatus," but rather reniform. It agrees better with *H. apiaria*, a specimen of which is in the herbarium at Kew. It was collected by John Marquis near Brisbane (*F. M. Bailey*, no. 408).

175. Hexagonia decipiens, Berk. in Lond. Journ. of Botany, 1845, iv. p. 57. (Plate XII. fig. 3.)

Gippsland, Victoria, *Miss F. M. Campbell*. (*F. M. Bailey*, nos. 336. 12. and 347. 4).

In no. 347. 4 the pores are rather larger than in no. 336, which seems to be the only difference.

176. HEXAGONIA TENUIS, Hook. (Plate XII. figs. 4–6.) In Kunth, Synop. p. 10. Brisbane (*F. M. Bailey*, no. 375).

177. HEXAGONIA RIGIDA, Berk. in Linn. Soc. Journ. vol. xvi. p. 54. (Plate XII. figs. 7–11.) Brisbane (*F. M. Bailey*, no. 348).

178. HEXAGONIA MÜLLERI, Berk. in Linn. Soc. Journ. vol. xiii. p. 166. (Plate XII. figs. 12, 13.)

The specimen from Brisbane answers better to the description of this species, although it comes near to *H. tenuis* and *H. variegata.* Brisbane (*F. M. Bailey*, no. 342).

179. LASCHIA CÆSPITOSA, Berk. in Lond. Journ. of Botany, 1854, p. 229. Brisbane (*F. M. Bailey*, nos. 158 and 238).

180. MERULIUS BAILEYI, Berk. & Broome, n. sp. (Plate XIII. fig. 1.) Aurantius, pileo flabelliformi viscido glabro, margine crenato rugoso inflexo, carne flava, poris marginis irregularibus quantillum radiantibus, dissepimentis obtusis flexuosis.

"This species is almost orange-coloured when fresh; it contracts much in drying. The hymenium seems sometimes like that of a *Dædalea.*"—*F. M. B.* It seems to partake of the characters of both the genera; but its texture and general habit resemble rather those of *Merulius.* The upper surface of the pileus is lacerate, especially at the margin, where it is strongly incurved when dry; the hymenium is reticulate in some places, in others it exhibits folds; in a small specimen laterally confluent with the larger one, the folds assume the appearance of gills; the colour when dry is a dark rusty brown, the original orange tint is perceptible here and there on the upper surface. The larger specimen is about 2 inches wide by $1\frac{1}{2}$ long, the lesser ones about $\frac{3}{4}$ of an inch. Brisbane (*F. M. Bailey*, no. 171).

181. MERULIUS TENUISSIMUS, Berk. & Broome, n. sp. Papyraceus, umbrino-fuscus, subtus et margine tenuissimus, albus, plicis subreticulatis distantibus leviter elevatis

Parasitic apparently on some *Hymenochæte*, on whose hymenium it forms very thin irregular closely adherent patches of a yellowish-brown colour, which exhibit extremely delicate reticulations towards their centre, measuring about $\frac{1}{4}$ of a line across the inner substance shown where the hymenium is cracked, and at the margin is nearly white. Brisbane (*F. M. Bailey*, no. 173).

182. PHLEBIA RADIATA, Fr.

On the same beam with *Hydnum merulioides.* Brisbane (*F. M. Bailey*, no. 247).

183. CRATERELLUS CORNUCOPIOIDES, Fr. Brisbane (*F. M. Bailey*, no. 414).

184. SISTOTREMA IRPICINUM, Berk. & Broome, n. sp. (Plate XIII. figs. 2, 3.) Pileo subcuticulari, crasso, subtiliter tomentoso, pallido, postice longissime descendente; hymenio umbrino; poris irregularibus hic illic lamellosis, in parte descendente irpicinis quandoque cavis.

Pileus $1\frac{1}{2}$ inch wide, nearly as much long, thick, rigid, pallid, very minutely tomentose. Hymenium porous, the pores very irregular, splitting up more or less into laminæ, and where the fungus descends into very hydnoid divisions, which are at times hollow, after the fashion of Pers. 'Mycol. Europ.' t. xviii. fig. 5. The teeth or, rather, tubes are often perforated at the end. On old logs. Brisbane (*F. M. Bailey*, no. 313).

185. HYDNUM (§ APUS) MERULIOIDES, Berk. & Broome, n. sp. (Plate XIII. fig. 4.) Pileo dimidiato, crasso, extus glabro, pallido, lineis prominulis rugoso; hymenio vivide aurantiaco, aculeis cylindricis obtusis.

Pileus 3 inches across, nearly 2 long; aculei about 1 line long, at first sight closely resembling *Merulius tremellosus*; but the hymenium is that of a *Hydnum*. On the timber of a bridge, Brisbane (*F. M. Bailey*, no. 246).

186. HYDNUM GILVUM, Berk. in Lond. Journ. of Botany, 1851, p. 168.

Pileus about $1\frac{1}{2}$ inch wide, 1 inch long, brown when dry, slightly tomentose; spines bright gilvous, $1\frac{1}{2}$ to 2 lines long, collected in little fascicles when dry, acute and smooth, paler at the tips. Brisbane (*F. M. Bailey*, no. 169).

187. RADULUM MOLARE, Fr. Brisbane (*F. M. Bailey*, no. 234).

188. IRPEX TABACINUS, Berk. & Cooke. Brisbane (*F. M. Bailey*, no. 345).

189. CLADODERRIS DENDRITICA, Pers. (*Thelephora dendritica*, Fr.) North Queensland, *Rev. J. E. T. Woods* (*F. M. Bailey*, no. 356.).

190. THELEPHORA (§ MESOPUS) SPONGIÆPES, Berk. "Australian Fungi," Linn. Soc. Journ. vol. xviii. p. 385. (Plate XIV. figs. 1, 2.)

Agreeing in general character with the above, but much higher, being 3 inches high when dry; the spongy base is $\frac{3}{4}$ inch, and brown. Collected by the Rev. B. Scortechini, Logan River, Australia (*F. M. Bailey*, no. 409).

191. THELEPHORA CRISTATA, Fr. Brisbane (*F. M. Bailey*, no. 403).

192. THELEPHORA PEDICELLATA, Schwein. Car. t. 2. fig. 3. Brisbane (*F. M. Bailey*, no. 150).

193. HYMENOCHÆTE RUBIGINOSA, Lév. Brisbane (*F. M. Bailey*, no. 276).

194. STEREUM (§ MESOPUS) NITIDULUM, Berk. in Lond. Journ. of Botany, 1843, p. 638. Brisbane (*F. M. Bailey*, nos. 127, 388).

195. STEREUM (§ MESOPUS) ELEGANS, Fr. Gippsland, Victoria, *Miss F. M. Campbell*, no. 46 (*F. M. Bailey*, no. 403. 46.)

196. STEREUM (§ PLEUROPUS) SPATHULATUM, Berk. in Lond. Journ. of Botany, viii. 274. (Plate XIV. figs. 3–7.) Brisbane (*F. M. Bailey*, no. 427).

197. STEREUM (§ MERISMA) FASCIATUM, Schwein. Syn. 106, no. 1011. Brisbane (*F. M. Bailey*, no. 279).

198. STEREUM (§ MERISMA) RADIATO-FISSUM, Berk. & Broome, n. sp. (Plate XIV. figs. 8–11.) Pileis multifidis subinvolutis vel basi divisa oriundis, spadiceis nitidis multizonatis, apice laceris, hymenio lævi pallido.

Growing in dense masses, stipitate, stem narrow, gradually expanded upwards; pileus beautifully zoned with dull ochre and red-brown bands, $\frac{1}{2}$ to $\frac{3}{4}$ inch high, silky above; hymenium pallid and smooth, margin jagged, incurved and crisped when dry. On dead wood. Brisbane (*F. M. Bailey*, no. 277). In no. 278 the pileus is less distinctly divided, rather consisting of an aggregation of distinct, oblong, subspathulate individuals, which are more or less confluent, whereas in no. 277 the divisions run down into a distinctly divided stem. A variety of this species, or perhaps the same in a more advanced condition, was sent under no. 319. It does not curl up in the same way, and the hymenium is dull brown.

199. STEREUM (§ MERISMA) ILLUDENS, Berk. in Lond. Journ. of Botany, 1845, p. 59. Brisbane (*F. M. Bailey*, nos. 145, 215).

200. STEREUM (§ MERISMA) SIMULANS, Berk. & Broome. (Plate XIII. figs. 5–15.) Pileo orbiculari rigido rugoso tomentoso margine reflexo, hymenio glabrato pallido-ochraceo, contextu rhabarbarino.

This species is intermediate between *S. rugosum* and *S. lobatum*. The pileus is tomentose, gilvous, slightly reflexed and zoned; the hymenium uneven, glabrous, of a brownish ochre colour, and concentrically zoned, fixed by the centre; when young cup-shaped; the substance rhubarb-coloured. It is much more rigid than *S. lobatum*, differing from *S. rugosum* in the substance of the pileus. Brisbane (*F. M. Bailey*, nos. 162, 163, 225).

201. STEREUM (§ MERISMA) COMPLICATUM, Fr. (Plate XIV. figs. 12–14.) Brisbane (*F. M. Bailey*, no. 278).

202. STEREUM (§ APUS) HIRSUTUM, Fr. Brisbane (*F. M. Bailey*, nos. 145, 185).

203. AURICULARIA MESENTERICA, Bull. Brisbane (*F. M. Bailey*, no. 394).

204. AURICULARIA LOBATA, Sommerf. in Fr. Summa Veg. Scand. p. 333.

The difference of this species from *Hirneola polytricha* is very slight. Brisbane (*F. M. Bailey*, no. 133).

205. CORTICIUM INCARNATUM, Fr. Brisbane (*F. M. Bailey*, no. 149).

206. CORTICIUM AMORPHUM, Fr.

This plant closely resembles in habit and colour *C. amorphum*. It seems immature; but the spores are not like the bodies supposed to be the spores in the species alluded to, but resemble those of a *Cyphella*, ovate, pointed at each end, and 0·0009 inch long. Brisbane (*F. M. Bailey*, no. 351).

207. CORTICIUM ARACHNOIDEUM, Berk. in Ann. Nat. Hist. 1844, ser. i. vol. xiii. p. 345.

Apparently an early state of this species. Brisbane (*F. M. Bailey*, no. 147).

208. CORTICIUM BAMBUSICOLA, Berk. & Broome, n. sp. Subrotundum, gilvum, scabridum, tenue, margine subfimbriato concolori, sporis globosis brunneis lævibus.

Forms roundish patches of a dull ochraceous or gilvous colour, cracked in drying, and slightly fimbriate at the margin; the substance is composed of loose branched threads closely adhering to the matrix; the surface is rough under the lens with conical cystidea and brown spherical spores, 0·0004 to 0·00045 inch in diameter. It would come under the subgenus *Peniophorus* of Cooke. The attachment of the spores has not been seen. On rotting Bamboos. Brisbane (*F. M. Bailey*, no. 143).

209. Hypochnus rubro-cinctus, Ehrb. in N. A. Hor. Phys. Berol. 84. t. 17. f. 5. Brisbane (*F. M. Bailey*, no. 229).

210. Guepinia spathularia, Fr. Gippsland, Victoria, *Miss F. M. Campbell* (*F. M. Bailey*, no. 336. 22).

211. Clavaria portentosa, Berk. & Broome. (Plate XIV. fig. 15.) Albida, stipite subcylindrico scabroso repetiter ramosissimo, apicibus elongatis subulatis sursum obscuris, ipso apice pallidis, hic illic subclavatis.

Amongst dead leaves. Stem 2½ inches high, dilated upwards, where it is 1 inch thick; head about 2 inches high, the whole mass rather broader.

Clavaria Botrytis came under the same number, but it differs entirely in the mode of branching. Brisbane (*F. M. Bailey*, no. 426 in part).

212. Clavaria Botrytis, Pers. Brisbane (*F. M. Bailey*, no. 426 in part).

213. Clavaria miltina, Berk. in Lond. Journ. of Botany, 1852, p. 140. Brisbane (*F. M. Bailey*, no. 241).

214. Clavaria cristata, Holms.

Spores globose, 0·0003 inch in diameter. Brisbane (*F. M. Bailey*, no. 300).

215. Clavaria rufa, Fl. Dan. Brisbane (*F. M. Bailey*, no. 387).

216. Calocera cornea, Fr. Brisbane (*F. M. Bailey*, no. 406).

217. Dacrymyces Sacchari, Berk. & Broome, n. sp. Massa irregularis gelatinosa aurantio-rubra in stromate albido insidens; stratum tenue sistit in caulibus exustis Sacchari officinarum. Conidiis subglobosis irregularibus diffluentibus.

The fungus consists of irregular flattish masses of a reddish orange-colour, seated on a dirty-white stroma, which spreads over the charred stems of sugar-cane. The threads which constitute these masses are large, but delicate, easily breaking up at the joints, and throwing off from their tips subglobose conidia, as in the case of *Dacrymyces lacrymalis*. True spores have not been seen. Brisbane (*F. M. Bailey*, no. 352).

218. Tremella mesenterica, Retz, in Act. Holm. 1769, p. 249. Gippsland, Victoria, *Miss F. M. Campbell* (*F. M. Bailey*, no. 336).

219. Tremella lutescens, Fr. Brisbane (*F. M. Bailey*, no. 423).

220. Dictyophora multicolor, Berk. & Broome, n. sp. (Plate XIV. fig. 16.) Capitulo aurantiaco reticulis parvis, velo pulcherrime citrino; stipite basi attenuato pallide alutaceo.

Head bright orange, perforated at the apex, with little cavities filled with the dark spores; net bright lemon-colour, not spreading widely; reticulations large; stem cream-coloured, attenuated at the base. Odour fœtid, as in the *Phalloidei*, but not so strong as in *Aseroë*; spores oblong, 0·0002 inch long.

Mr. Bailey's sketch of this species does not represent the stem as marked with reticulations below the net; but the dry specimen appears as if it were so; the net extends about halfway down the stem. The plant was given to Mr. Bailey by a friend, and there was no volva with it; but it had probably been broken off by the finder. The height of the entire fungus was about 7 inches. The stem was hollow and inflated. Brisbane (*F. M. Bailey*, no. 245). We are indebted to Miss E. Ellis, of Hereford, for a beautiful coloured drawing of this species composed from coloured sketches sent us by Mr. Bailey.

221. PHALLUS CALYPTRATUS, Berk. & Broome, n. sp. (Plate XIV. fig. 17.) Curtus, pileo aurantiaco, calyptra albida glabra terminato, stipite pallido, subæquali.

Pileus $\frac{1}{2}$ inch across, stem $1\frac{1}{2}$ inch high, slightly attenuated above, $\frac{1}{3}$ inch thick. On bursting through the uterus this species carries up the upper part along with it; and it then forms a covering resembling the calyptra of mosses; at least it is so in the single specimen found by Mr. Bailey. Among grass. Brisbane (*F. M. Bailey*, no. 290).

222. PHALLUS QUADRICOLOR, Berk. & Broome, n. sp. (Plate XIV. fig. 18.) Pileo conico, apice perforato, basi latissima, aurantiaco, reticulato, (sicco) brunneo, sporis ovatis pallide brunneis obducto, mycelio purpureo, stipite reticulato.

Head conical, 2 inches long, very wide at the base, orange-coloured, coarsely reticulated, brown when dry, clothed with pale brown ovate spores, 0·0003 inch long; stem reticulate, lemon-coloured, $2\frac{1}{2}$ inches long, from the pileus to the volva about $1\frac{1}{2}$ inch long, white; mycelium purple. It is related to *Phallus aurantiacus*, Mont., but differs in its conical head, which is much wider at the base. It is remarkable for its perforated orange-coloured head, lemon stem, and especially for its purple mycelium. Found by Mr. Thomas Weedon, of Woolongabba, Queensland.

The measurements are taken from a pencil-sketch accompanying the specimen (*F. M. Bailey*, no. 354).

223. CYATHUS VERNICOSUS, DC. (*Nidularia campanulata*, Sow.) Brisbane (*F. M. Bailey*, no. 378).

224. MITREMYCES VIRIDIS, Berk. in Lond. Journ. of Bot. 1851, p. 201. Gippsland, Victoria, *Miss F. M. Campbell* (*F. M. Bailey*, no. 418).

225. HYDNANGIUM AUSTRALIENSE, Berk. & Broome, n. sp. Subglobosum, peridio crasso, (sicco) rugoso, rufo-brunneo, carnę pallide ochracea, cellulis vacuis laxis e puncto basilari oriundis; sporis globosis, minute echinulatis.

This species has very much the appearance of *Rhizopogon luteolus*, Fr.; but the globose spores distinguish it at once from that plant. The spores are minutely echinulate, and measure 0·0004 to 0·0005 inch in diameter, or about 0·012 millim. The nearest species to it is *Hydnangium carneum*, Wallr., if it be really distinct; it differs in its spores, which are much less echinulate than in that species, and in the colour of the flesh, which Tulasne describes as dilutely flesh-coloured. A single specimen only occurred. Brisbane (*F. M. Bailey*, no. 188).

226. GEASTER FLORIFORMIS, Vitt. Mon. Tuber. 18. Brisbane (*F. M. Bailey*, no. 214).

227. POLYSACCUM PISOCARPIUM, Fr. Brisbane (*F. M. Bailey*, no. 177).

228. LYCOPERDON CÆLATUM, Fr. Brisbane (*F. M. Bailey*, no. 208).

228 bis. CHONDRIODERMA DIFFORME (Pers.). Brisbane (*F. M. Bailey*, no. 379).

229. ÆTHALIUM SEPTICUM, Fr. Brisbane (*F. M. Bailey*, no. 413).

230. ARCYRIA NUTANS, DC. Fl. Fr. ii. 254. Brisbane (*F. M. Bailey*, no. 130).

231. ARCYRIA CINEREA, Pers. Dispos. Fung. x. t. 1. fig. 2. Brisbane (*F. M. Bailey*, no. 132).

232. ARCYRIA INCARNATA, Pers. Observ. i. 58, pl. v. figs. 4, 5. Brisbane (*F. M. Bailey*, no. 169).

233. RŒSTELIA POLITA, Berk. (Plate XV. figs. 1–5.) Clavulis sursum incrassatis pallide succineis, lævibus vel subtiliter tomentosis, e basi villosa crassa oriundis.

This very curious species consists of long spines, which are sometimes acute, at others slightly thickened upwards, of a pale amber-colour, smooth, but dotted over with little glands, proceeding from a shaggy or foliaceous base. The hairs clothing the base are lancet-shaped ; the spores (?) are globose, about 0·0003 inch in diameter. The clavules are about $\frac{3}{4}$ of a line high, the head continuous with the stem and cellular throughout. The plant is identical with a specimen in the Kew herbarium, and is growing on the same plant, *Jacksonia scoparia*, R. Br. Brisbane (*F. M. Bailey*, no. 370).

234. ÆCIDIUM NYMPHOIDEARUM. *Æ. nymphoidis*, DC. Fl. Fr. ii. 597. Brisbane (*F. M. Bailey*, no. 424).

235. PUCCINIA GRAMINIS, Pers. A small form. Brisbane (*F. M. Bailey*, no. 353).

236. USTILAGO EMODENSIS, Berk. in Lond. Journ. of Bot. 1851, p. 202.

Spores minutely rough, 0·0005 to 0·0006 inch across. In swollen stems of some species of *Polygonum*. Brisbane (*F. M. Bailey*, no. 289).

237. TILLETIA EPIPHYLLA, Berk. & Broome, n. sp. Pustulis brevibus epiphyllis, sporis globosis lævibus pallide fuscis.

Pustules from $\frac{1}{4}$ to $\frac{1}{2}$ a line in length, pale brown, occupying a yellowish spot on leaves of maize. Spores smooth, globose, about 0·0014 inch in diameter, filled with granules. *Uredo maydis*, DC., is a much larger plant, with much smaller spores. Brisbane (*F. M. Bailey*, no. 228).

238. MELAMPSORA PHYLLODIORUM, Berk. & Broome. (Plate XV. figs. 6–8.) Soris in tuberculis alligenis sitis, sporis e filamentis delicatis oriundis subfusiformibus insigniter granulatis, aliis elongatis uniseptatis fusiformibus lævibus immixtis.

Large spores, beautifully granulated, pear-shaped, 0·0023 inch long; the narrow elliptic bodies, mixed with the large spores, are 0·0009 inch long. It is possible that the latter may be produced by some distinct parasite. On phyllodia of *Acacia*. (Plate XV. figs. 6, 7, large spores, fig. 8 small elliptic spores.) Brisbane (*F. M. Bailey*, nos. 269, 301).

239. MELAMPSORA NESODAPHNES, Berk. & Broome. (Plate XV. fig. 9.) Sporis massam pulverulentam villosam ochraceam in superficie fructus *Nesodaphnes obtusifoliæ* formantibus.

The swollen and distorted fruit is covered with the dusty ochraceous spores, mixed with villous matter, constituted apparently of the stalks of the spores; spores oblong or pear-shaped, finely granulated, varying in length from 0·0005 to 0·0015 inch ; the stem frequently remains adherent to the spores. Brisbane (*F. M. Bailey*, no. 344). This plant possesses a peculiar odour resembling the smell of a chemist's shop.

240. Aspergillus glaucus, Link. Species Plant. i. 67. On seeds of maize. Brisbane (*F. M. Bailey*, no. 304).

241. Ceratium arbuscula, Berk. & Broome, in Linn. Soc. Journ. vol. xiv. p. 97. Brisbane (*F. M. Bailey*, no. 396).

242. Fusarium rubicolor, Berk. & Broome, n. sp. (Plate XV. figs. 10, 11). Effusum, griseo-carneum, sporis elongatis 3–4-septatis, apice latioribus.

On leaves of *Eucalyptus*, spreading over galls, probably produced by a small Acarus; spores 0·002 inch long; they spread over the leaves and colour them, especially the veins, of a tint like that of raspberry-cream. Brisbane (*F. M. Bailey*, gall no. 5).

243. Microcera coccophila, Desm. Brisbane (*F. M. Bailey*, no. 383).

244. Illosporium flavellum, Berk. & Broome, n. sp. (Plate XV. figs. 12–14.) Stipitatum flavidum, sporis globosis.

Forming a yellow stroma on lichens; the plant consists of roundish stipitate bodies, sometimes jagged at the edge. Spores round, terminal; when crusted they are seen to consist of a granular mass containing ovate vacuoles 0·0005 inch long. Brisbane (*F. M. Bailey*, no. 273).

245. Oidium leucoconium, Desm. On gourd leaves. Brisbane (*F. M. Bailey*, no. 235).

246. Antennaria semiovata, Berk. in Ann. Nat. Hist. ser. ii. vol. xiii. p. 468.

This differs slightly from the plant described in the Annals of Natural History; but there are not sufficient characters to distinguish it. Brisbane (*F. M. Bailey*, no. 178).

247. Sphæropsis Tricorynes, Berk. & Broome. Peritheciis minutis nigris in parenchymate foliorum immersis, sporis ellipticis.

The very minute black perithecia are imbedded in the substance of the leaves; the elliptic spores are seated on short stalks, and measure 0·0012 inch in length. Endeavor River, *Rev. J. E. T. Wood*, on leaves of *Tricoryne anceps* (*F. M. Bailey*, no. 359).

248. Graphiola Phœnicis, Fr. On date-palm, Brisbane (*F. M. Bailey*, no. 303).

249. Glœosporium Cucurbitarum, Berk. & Broome, n. sp. Maculis læte aurantiacis depressis cirriferis, sporis clavatis breviter stipitatis.

Small cirri arise from depressed patches on the cuticle, which are composed of clavate spores, which, as well as the patches, are of bright orange-colour. The spores vary from 0·0004 to 0·0009 inch in length. On the skin of some gourds. Brisbane (*F. M. Bailey*, nos. 371, 393).

250. Torula herbarum, Link. Observ. i. 19.

The spores are more loosely arranged than in the common form. Brisbane (*F. M. Bailey*, no. 310).

251. Cladosporium papyricolor, Berk. & Broome, n. sp. Filamentis irregulariter ramosis, supra hyalinis, infra brunneis, sporis numerosis oblongis pallide brunneis binucleatis.

Threads alternately and irregularly branched, hyaline above, pale brown below; spores ovate-oblong, pale brown, numerous, having two nuclei, about 0·0008 inch long. Brisbane (*F. M. Bailey*, no. 128). It forms a grey-black stratum on damp paper.

252. PHILLIPSIA SUBPURPUREA, Berk. & Broome, n. sp. Cupulis planis margine lobatis centro affixis; hymenio subpurpureo, sicco brunneo, subtus primum albido dein præcipue margine sublateritio; sporidiis uniserialibus, late ellipticis, ·0015 unc., paraphysibus filiformibus æqualibus.

Brisbane (*F. M. Bailey*, no. 167). Cups at length plane, sessile; disk purplish, when dry dark purple, externally rugose from contraction in drying. Asci equal, containing 8 oblong smooth sporidia, 0·0008 to 0·0015 inch long, about half the width; paraphyses linear. "Grows on wood close to the ground."—*F. M. B.*

253. PEZIZA CONFUSA, Cooke, in Bullet. Buffalo Acad. vol. ii. p. 291, and Mycog. pl. 32.

The Brisbane plant agrees closely with Mr. Cooke's species; only the colour is more pallid and the hairs less developed. Sporidia globose, 0·0005 inch diam. (Cooke, Mycographia, ii. t. 32. fig. 124.) Brisbane (*F. M. Bailey*, no. 166).

254. PEZIZA HIRTA, Schum. Gippsland, Victoria, *Miss F. M. Campbell* (*F. M. Bailey*, no. 347. 8).

255. PEZIZA (§ LACHNEA) COPROGENA, Berk. & Broome, n. sp. Cupulis subaurantiacis, pilis obtusis pallide badiis nec cruciatis vestitis; sporidiis elliptico-oblongis nitidis glaberrimis; paraphysibus obtusis.

Much paler than *P. stercorea*, with longer sporidia, and not a trace of cruciate or peltate hairs. Sporidia 0·0015 inch long. Brisbane (*F. M. Bailey*, no. 205).

256. HELOTIUM TERRESTRE, Berk. & Broome, n. sp. (Plate XV. figs. 15–17.) Parvum, planiusculum, cornicolor luridum, extus villosum; ascis elongatis, sporidiis uniserialibus ellipticis utrinque breviter appendiculatis.

Cups $\frac{1}{6}$ inch across; stem $\frac{1}{24}$ inch high; sporidia uniseriate, 0·0004 inch long, elliptic, with a little globule at each extremity; paraphyses linear, sometimes slightly clavate at the tips. Brisbane, on damp earth (*F. M. Bailey*, no. 299).

257. ASCOBOLUS BAILEYI, Berk. & Broome, n. sp. Cupulis primum ochraceis concavis, demum vinoso-brunneis explanatis, extus leviter granulatis, ascis prominentibus, sporidiis brunneis ovatis lævibus, paraphysibus linearibus,

Cups at first of a dull ochre colour, at length of a vinous brown, flat, with a raised and slightly incurved margin, externally granulated, not at all furfuraceous or farinose, 2–3 lines across when mature; asci rather clavate; sporidia sometimes in one, at others in two rows, of a clear hyaline brown colour, 0·0006 to 0·0007 inch long, ovate or elliptic; paraphyses equal in length to the asci, generally linear, sometimes a little swollen at the summit. The projecting asci show it to belong to the *Ascoboli*; it, however, resembles Cooke's fig. of *Peziza scatigena* (Mycographia, fig. 72); but it is not farinaceous externally, and the sporidia are smaller. It would come under Boudier's genus *Ascophanus* but for the sporidia, which are of a clear distinct brown colour. On dung, Brisbane (*F. M. Bailey*, no. 252).

258. PATELLARIA LIGNYOTA, Fr.

Some of the cups are shortly stipitate. *Miss F. M. Campbell*, no. 15 Gippsland, Victoria (*F. M. Bailey*, no. 347).

259. HYPOCREA MEMBRANACEA, Berk. & Broome, n. sp. Tenuissima membranacea alutacea, peritheciis sparsis pallide aurantiacis.

Forming at first a very thin byssus, which gradually forms a membrane nowhere thicker than silver-paper, and thinner at the margin. Unfortunately the perithecia are not mature; but they are sufficient to determine the affinities. Parasitic on some *Polyporus*, Brisbane (*F. M. Bailey*, no. 181).

260. NECTRIA COCCINEA, Fr.

A curious state of this species, the ostiola being depressed and not always central and dark-coloured; the lateral ostiolum and compressed form may arise from the crowded condition of the perithecia. Brisbane (*F. M. Bailey*, no. 284).

261. SPHÆROSTILBE CINNABARINA, Tul. Carp. iii. p. 103. (Plate XV. fig. 18.)

This differs somewhat from Tulasne's plant in the more slender terete stems, which bear the globose heads of conidia, and rather resemble his figure of *S. gracilipes*, from which, however, it is distinct in colour; from *S. aurantiaca* it differs in the cylindrical not compressed and dilated stems. Montagne describes his *Stilbum cinnabarinum* as having capillary stems, which so far agree with the Brisbane plant; but his figure 3, t. ii. in Ram. de la Sagra, Hist. Ins. Cubæ, gives a very inadequate notion of the latter. We therefore think it safer to leave our plant under Tulasne's name. Brisbane (*F. M. Bailey*, no. 157).

The heads of conidia are bright ochre-coloured, the stems pale red, darker below, rough or subtomentose, the perithecia granulated and collapsed; the asci and sporidia are immature, the latter ovate, and about 0·0003 inch long, and not yet septate. Plate XV. fig. 18, a group of perithecia with a conidiiferous head.

262. PORONIA PUNCTATA, Fr. *Miss F. M. Campbell*, no. 19, Gippsland, Victoria (*F. M. Bailey*, no. 336).

263. PORONIA ŒDIPUS, Mont. in Ann. Sc. Nat. Cent. ii. no. 35, et Cuba, p. 346, t. 13. fig. 2. Brisbane (*F. M. Bailey*, no. 415).

264. HYPOXYLON CONCENTRICUM, Grev., var. MINUS.

A small form, black and shining; there seems to be no other difference from the common state. Brisbane (*F. M. Bailey*, no. 274).

265. HYPOXYLON SERPENS, Fr.

There seems to be no character to distinguish the British plant from that of Fries. Brisbane (*F. M. Bailey*, no. 197).

266. SPHÆRIA (§ SUBTECTÆ) POLYSCIA, Berk. & Broome, n. sp. (Plate XV. figs. 19–21.) Peritheciis immersis apice impressis; sporidiis ejectis ocellatis, sparsis vel confertis; mycelio aterrimo, punctato.

Scattered or immersed in dark, black, granulated mycelium; the perithecia are depressed at the summit, and ocellated with the escaped oblong or sausage-shaped sporidia, which are 0·0009 inch long. Asci short, 0·0035 inch long, containing two rows of sporidia. The appearance of the mycelium, dotted with the perithecia, under a low power is just like that of shagreen leather. On bottle-gourds, Brisbane (*F. M. Bailey*, no. 287).

267. Rhytisma hypoxanthum, Berk. & Broome, n. sp. Forma stylophora, maculis insulariformibus e folio incrassato flaccido facto oriundis; sporis brevibus, oblongis, 0·0003 unc. longis.

The parts of the leaves on which the fungus is developed are thickened uniformly and of a buff tint; spots irregular in shape, bright shining black, with a distinctly defined margin, here and there slightly granulated; basidia within the granules distinct, short, threadlike, bearing oblong stylospores 0·0003 inch long. Brisbane (*F. M. Bailey*, in a distinct set sent as probably galls, or of other insect-origin, no. 4 of the set).

268. Sphærella destructiva, Berk. & Broome. (Plate XV. figs. 22–24.) Peritheciis minutis in maculis brunneis sitis; ascis brevibus, sporidiis uniseriatis subellipticis basi subattenuatis.

It forms brown spots on leaves of Lucern on which the perithecia are seated; asci 0·0003 inch long; sporidia subelliptic, broader at one end, 0·0005 inch long, very injurious to the crops of Lucern. The brown spots consist of a delicate mycelium when viewed under a low power of the microscope. Brisbane (*F. M. Bailey*, no. 264).

269. Asterina Baileyi, Berk. & Broome, n. sp. (Plate XV. figs. 25–28.) Filamentis fuscis nodosis ramosis maculas rufo-brunneas in foliis ignotis formantibus; peritheciis minutis rugosis fuscis, fibrillis paucis adhærentibus; ascis clavatis, 8 sporidia brunnea continentibus.

It forms small reddish-brown patches on the leaves of some plant not named; the perithecia are rough and dark brown, subglobose, and seated on nodose branched threads of the same colour; asci clavate, containing 8 ovate biseriate sporidia, which are 1-septate, and constricted in the middle, brown, and about 0·0015 inch in length. Brisbane (*F. M. Bailey*, no. 129. No. 332 seems to be the same thing; but the patches are many times larger).

270. Meliola mollis, Berk. & Broome, in Linn. Soc. Journ. vol. xiv. p. 136.

Mr. Bailey's plant differs from the above in its rather smaller fruit, 0·0006 inch long, which contain nucleoli, and do not appear septate (this may be owing to its being in a younger state), and in its longer and more branched threads. The fruit in *M. mollis* from Ceylon was 0·0008 inch long, and distinctly uniseptate. Brisbane (*F. M. Bailey*, no. 330).

271. Meliola amphitricha, Fr. Brisbane (*F. M. Bailey*, no. 184).

272. Meliola corallina, Mont. Fl. Chile, vii. 472. (Plate XV. figs. 29–32.)

Perithecia globose, clothed with short broad spines, which are seated on a mycelium composed of coarse dark brown branched threads, beneath which is a stratum of delicate hyaline. Sporidia dark brown, 3–4-septate, oblong, 0·0023 to 0·0025 inch long by about 0·0007 inch wide. There is similar fruit in *Meliola amphitricha*, Fr.; there is also an unnamed species in the herbarium of Mr. Berkeley, from Khasia, which has similar sporidia. Brisbane (*F. M. Bailey*, nos. 288, 328).

273. Meliola Musæ, Mont. Ann. des Sci. Nat. 1846, t. v. p. 265. (Plate XV. figs. 33–36.)

The curved hairs surrounding the perithecia are rough, and of a very dark brown colour; the branched threads of the mycelium are hyaline, the sporidia dark brown, 4-septate, and 0·002 inch long. Some other sporidia, which are cellular, occur; but they seem to belong to some other species. Brisbane (*F. M. Bailey*, no. 329).

DESCRIPTION OF THE PLATES.

Plate X.

Fig. 1. *Lentinus exasperatus,* Berk. & Broome. Upper surface, nat. size. 1[a], small portion, enlarged.

Figs. 2, 3, 4, 5, & 6. *Lentinus punctaticeps,* Berk. & Broome, n. sp. In various aspects, from dried specimens.

Fig. 7. Ditto. Enlarged sketch of portion of the upper surface.

Figs. 8, 9, 10, & 10[a]. *Panus incandescens,* Berk. & Broome, n. sp. Nat. size, from dried specimens. 10[a], portion of the undersurface, showing the linear gills.

Figs. 11, 12, & 13. *Xerotus proximus,* Berk. & Broome, n. sp. Nat. size, as dried.

Figs. 14 & 15. *Xerotus albidus,* Berk. & Broome, n. sp. 14, Undersurface; 15, portion of upper surface. Nat. size, from dried specimen.

Fig. 16. *Polyporus* (§ *Pleuropus*) *dorcadideus,* Berk. & Broome, n. sp. Upper surface, nat. size. 16[a], portion of undersurface.

Figs. 17 & 18. *Polyporus* (§ *Inodermei*) *vellereus,* Berk. Nat. size. 17, under, & 18, upper surface; 17[a], small portion of the undersurface, enlarged.

Figs. 19 & 19[a]. *Polyporus* (§ *Placodermei*) *testudo,* Berk. & Broome, n. sp. Nat. size. 19[a], portion showing pores.

Plate XI.

Figs. 1–1[b]. *Polyporus* (§ *Placodermei*) *lineato-scaber,* Berk. & Broome, n. sp. Nat. size. 1, upper, and 1[a], portion of undersurface; 1[b], the same, enlarged.

Figs. 2–4. *Polyporus* (§ *Inodermei*) *contrarius,* Berk. & Cooke. Nat. size. 2 & 3, upper, and 4, undersurface.

Figs. 5 & 6. *Polyporus* (§ *Resupinatus*) *eriophorus,* Berk. and Broome, n. sp. Nat. size.

Figs. 7–9. *Dædalea scalaris,* Berk. & Broome, n. sp. Sections, nat. size.

Plate XII.

Figs. 1 & 2. *Dædalea incompta,* Berk. MSS.

Fig. 3. *Hexagonia decipiens,* Berk. Nat. size.

Figs. 4, 5, & 6. *Hexagonia tenuis,* Hook. Nat. size. 4 & 5, under, and 6, upper surface.

Figs. 7, 8, 9, 10, & 11. *Hexagonia rigida,* Berk. Nat. size. 7 & 8 upper, and 9, 10, and 11, under surface.

Figs. 12 & 13. *Hexagonia Mülleri,* Berk. Nat. size; 12, under, and 13, upper surface.

Plate XIII.

Fig. 1. *Merulius Baileyi,* Berk. & Broome, n. sp. Under surface, nat. size.

Figs. 2 & 3. *Sistotrema irpicinum,* Berk. & Broome, n. sp. Nat. size.

Fig. 4. *Hydnum* (§ *Apus*) *merulioides,* Berk. & Broome, n. sp. Under surface, nat. size.

Figs. 5 to 15. *Stereum* (§ *Merisma*) *simulans,* Berk. and Broome. Various views of specimens of nat. size, as dried.

Plate XIV.

Figs. 1 & 2. *Thelephora* (§ *Mesopus*) *spongiæpes*, Berk. Upper and under surface, nat. size.

Figs. 3 to 7. *Stereum* (§ *Pleuropus*) *spathulatum*, Berk., in various stages of growth, nat. size.

Figs. 8 to 11. *Stereum* (§ *Merisma*) *radiato-fissum*, Berk. & Broome, n. sp., nat. size, as dried.

Figs. 12 to 14. *Stereum* (§ *Merisma*) *complicatum*, Fr. Both surfaces as dried, nat. size.

Fig. 15. *Clavaria portentosa*, Berk. & Broome, nat. size.

Fig. 16. *Dictyophora multicolor*, Berk. & Broome, nat. size. Drawn by E. Ellis.

Fig. 17. *Phallus calyptratus*, Berk. & Broome, n. sp., nat. size.

Fig. 18. *Phallus quadricolor*, Berk. & Broome, n. sp., nat. size.

Plate XV.

Figs. 1 to 5. *Rœstelia polita*, Berk. 1, entire plant enlarged; 2, base of stem and basal hairs; 3, tip of stem; 4, lancet-shaped hairs; 5, the spores.

Figs. 6 to 8. *Melampsora phyllodiorum*, Berk. & Broome. 6 & 7, the large spores; 8, small elliptical spores: both highly magnified.

Fig. 9. *Melampsora Nesodaphnes*, Berk. & Broome. The spores in different stages, greatly magnified.

Figs. 10 & 11. *Fusarium rubicolor*, Berk. & Broome, n. sp. 10, plants on portion of *Eucalyptus*-leaf, enlarged; 11, spores, further enlarged.

Figs. 12 to 14. *Illosporium flavellum*, Berk. & Broome, n. sp. 12 & 13, enlarged plants; 14, spores and granular sinuses, highly magnified.

Figs. 15 to 17. *Helotium terrestre*, Berk. & Broome. 15, plant, enlarged; 16, asci and paraphyses, greatly enlarged; 17, spores, also highly magnified.

Fig. 18. *Sphærostilbe cinnabarina*, Tul. A group of perithecia with a conidiiferous head.

Figs. 19 to 21. *Sphæria* (§ *Subtectæ*) *polyscia*, Berk. & Broome, n. sp. 19, mycelium with perithecia 20, asci, enlarged; 21, sporidia, highly magnified.

Figs. 22 to 24. *Sphærella destructiva*, Berk. & Broome. 22, plant, slightly enlarged; 23, asci, greatly enlarged; 24, sporidia, highly magnified.

Figs. 25 to 28. *Asterina Baileyi*, Berk. & Broome, n. sp. 25, plant, nat. size; 26, enlarged; 27, asci, magnified; 28, sporidia, highly magnified.

Figs. 29 to 32. *Meliola corallina*, Mont. 29, plant, enlarged; 30, mycelium, greatly enlarged; 31, asci and paraphyses, and 32, spore, greatly magnified.

Figs. 33 to 36. *Meliola Musæ*, Mont. 33, perithecium and curved hairs, enlarged; 34, branched threads of mycelium, enlarged; 35, 36, sporidia, highly magnified.

Berkeley & Broome

A.Hammond lith.

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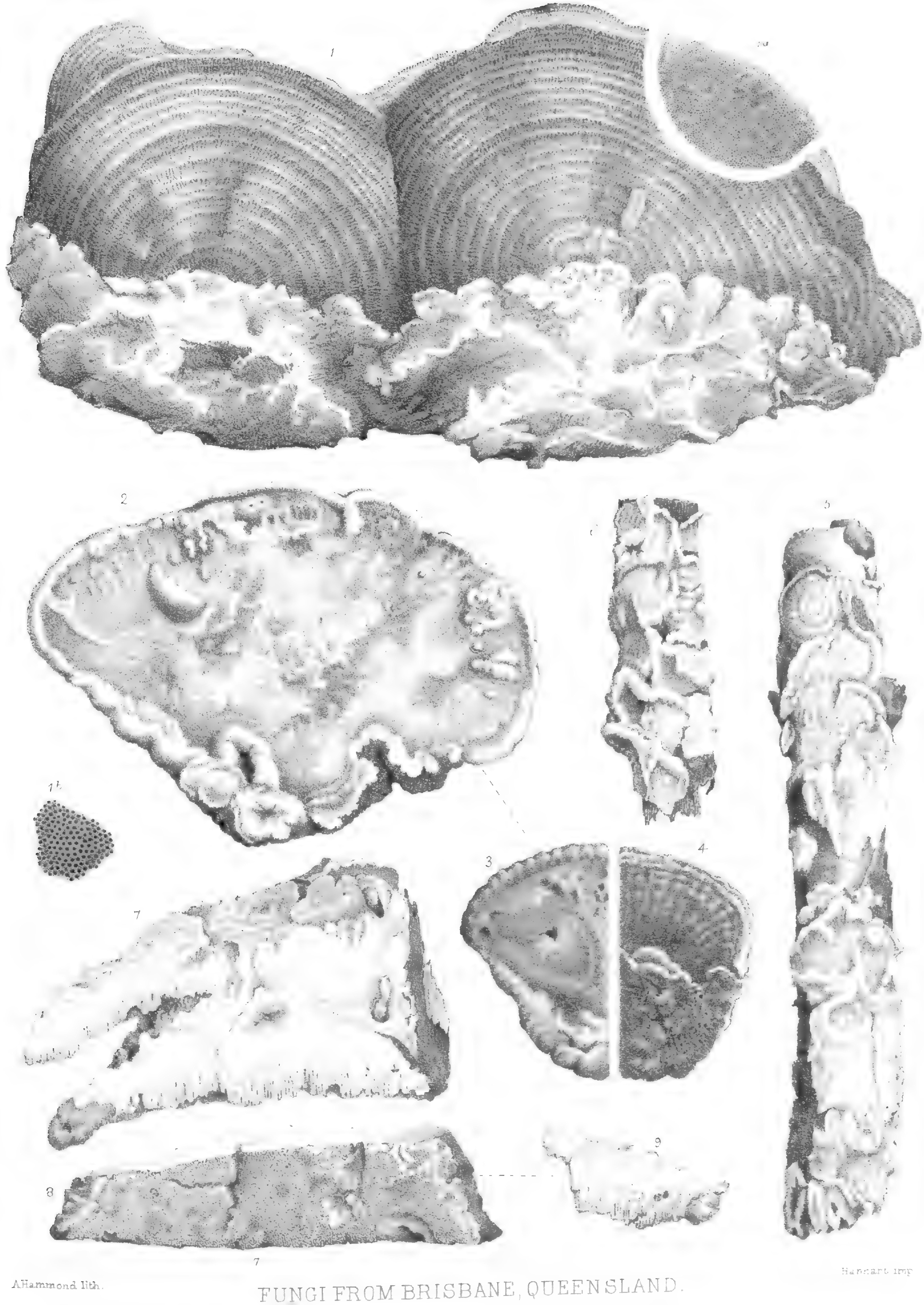
Berkeley & Broome



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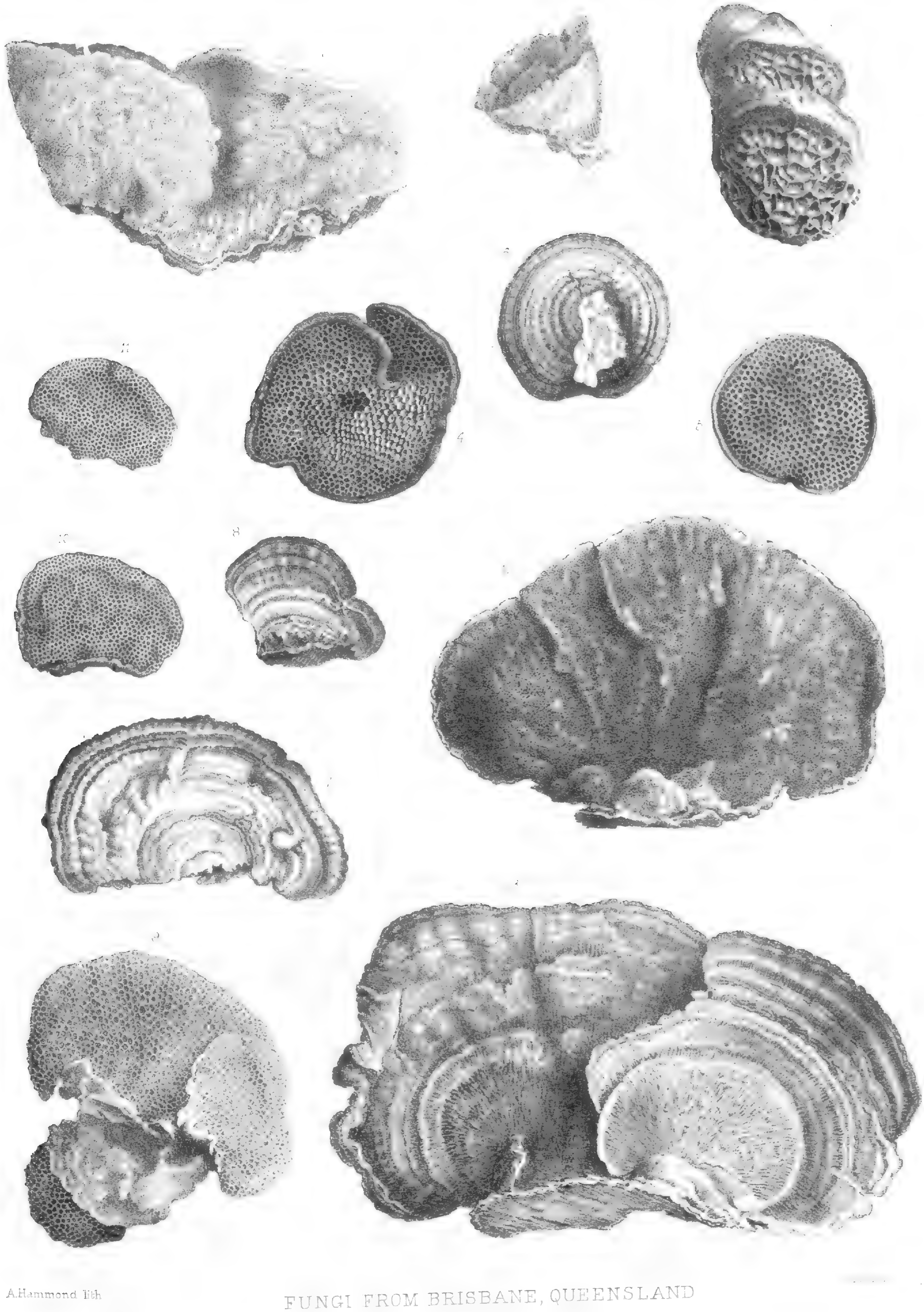

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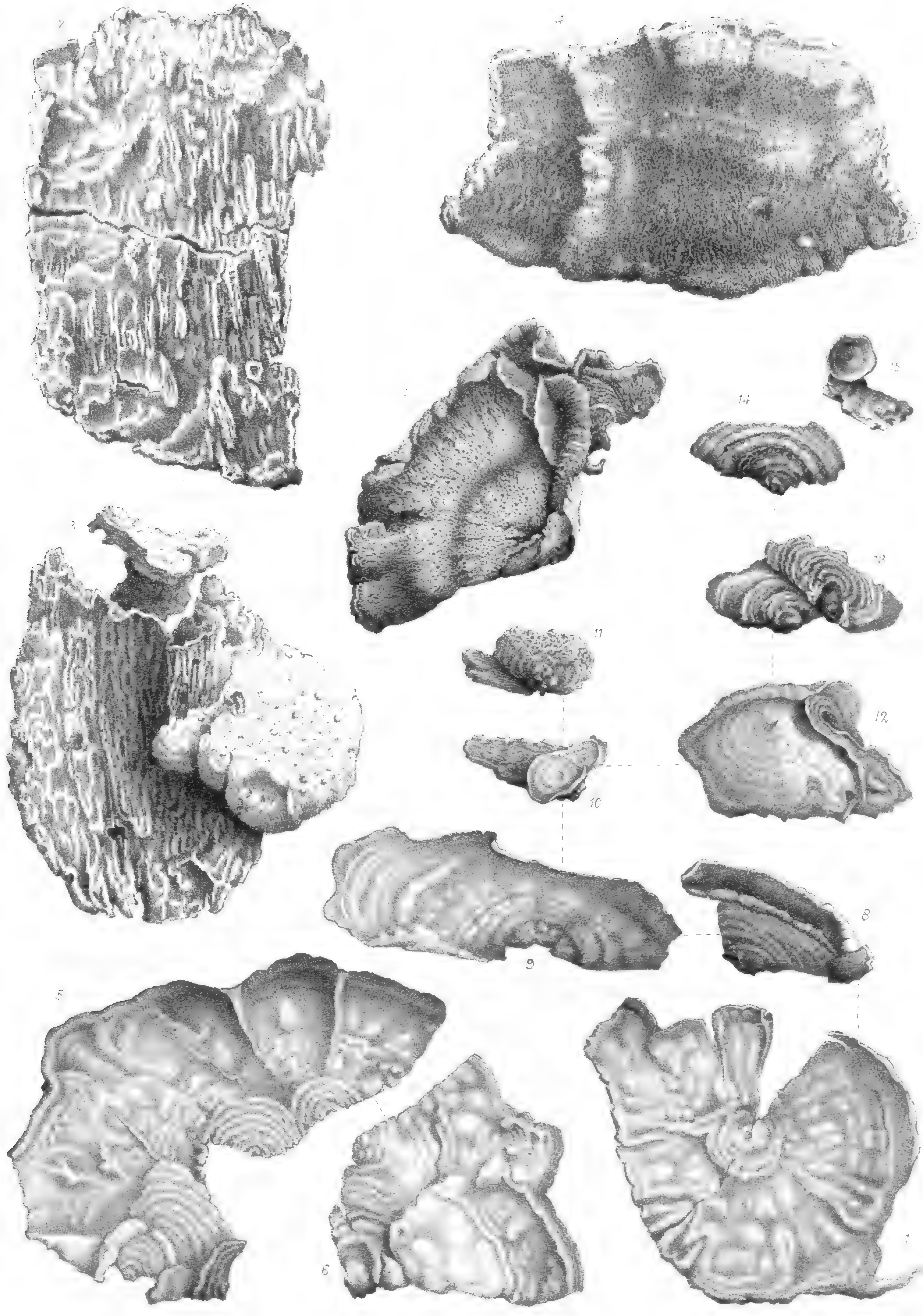

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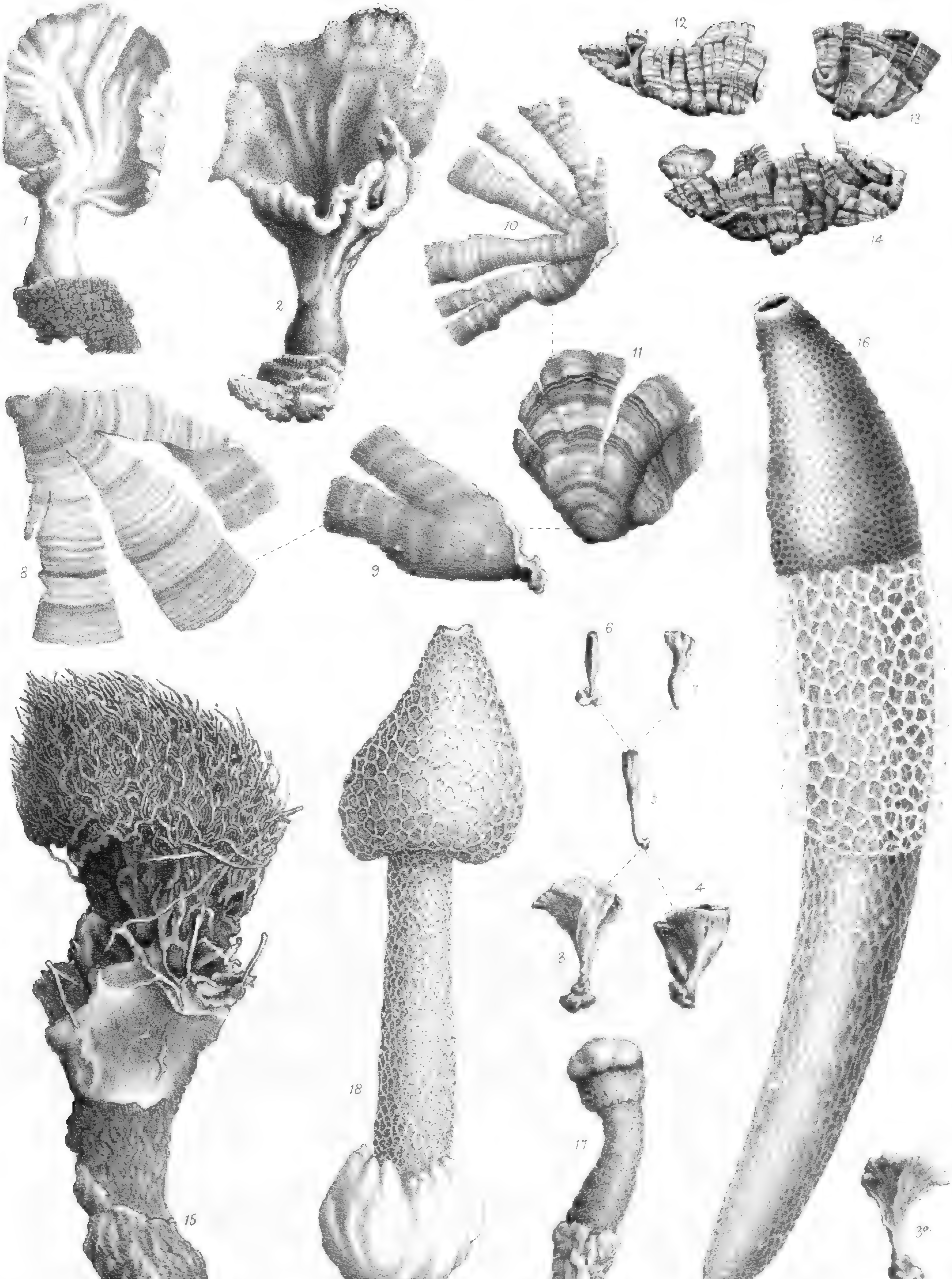

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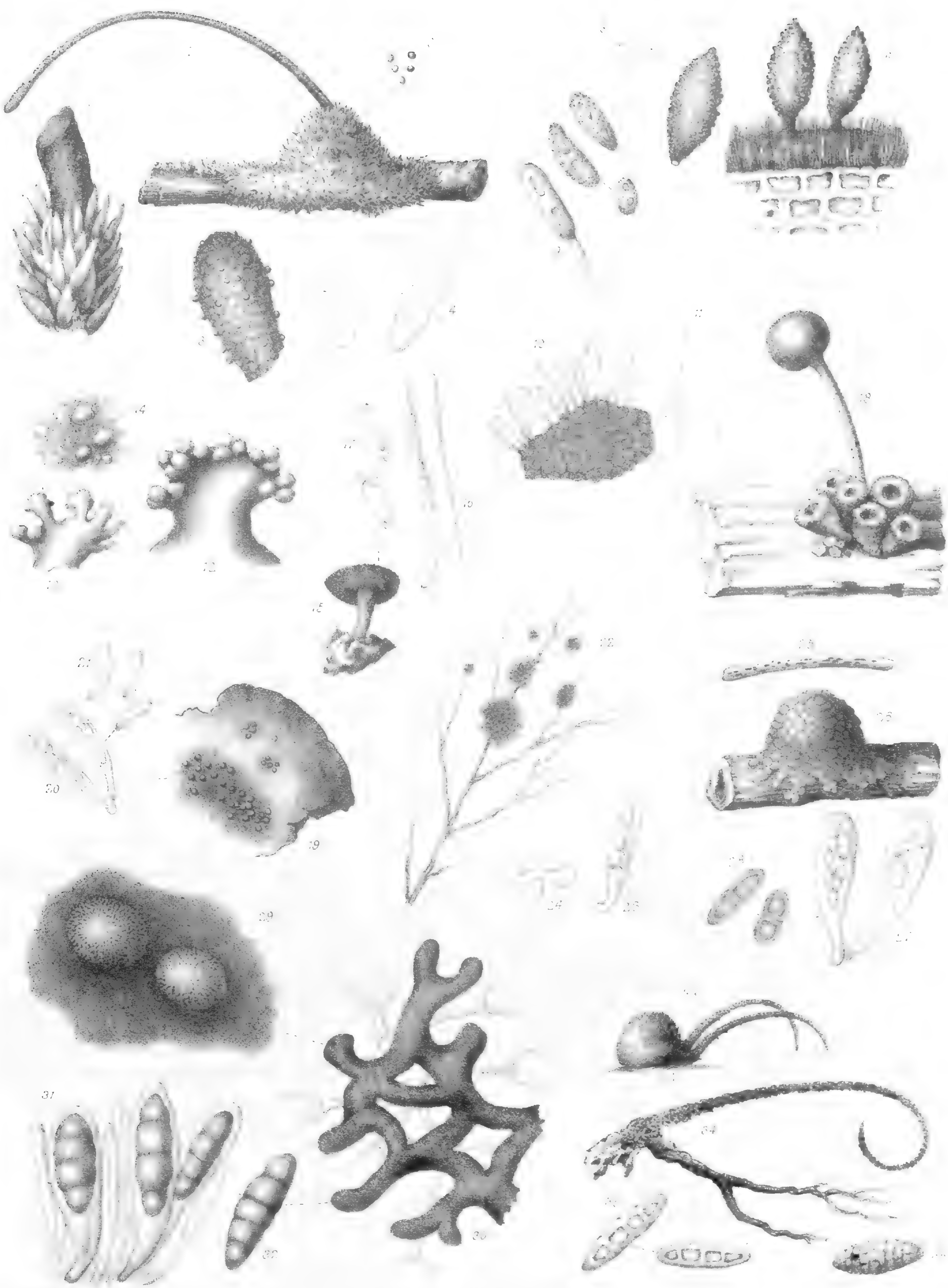

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THE

TRANSACTIONS

OF

THE LINNEAN SOCIETY OF LONDON.

ON THE MODE OF DEVELOPMENT

OF THE

POLLINIUM IN ASCLEPIAS CORNUTI, Decaisne.

BY

THOMAS H. CORRY, M.A., F.L.S.

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April 1883.

V. *On the Mode of Development of the Pollinium in* Asclepias Cornuti, *Decaisne. By*
THOMAS H. CORRY, *M.A., F.L.S., M.R.I.A., Shuttleworth and Foundation Scholar, Gonville and Caius College, and Assistant Curator of the University Herbarium, Cambridge.*

(Plate XVI.)

Read December 21st, 1882.

SO far as I have been able to ascertain, no observer has fully investigated, in an adequate manner, the whole mode of formation of the pollen-mass, or *pollinium*, in this genus and in the natural order to which it belongs.

Hofmeister* and Schacht† alone have thrown some light upon its history in the early stages, with, however, somewhat contradictory results, while Schleiden's ‡ account of it is incorrect in several respects and very fragmentary. Francis Bauer, Ehrenberg §, Robert Brown ||, Adolphe Brongniart ¶, and the younger Reichenbach **, have all recorded details more or less exact concerning its structure, but principally in some of the later stages, when the flower is becoming rapidly mature.

In the very young anther, which has the form of a very slightly flattened spatula with a strongly convex dorsal surface, I was able to trace in transverse section that a single cell of the hypodermal row lying laterally but towards the internal side of each lobe of the anther, and containing granular protoplasm and a prominent nucleus, had undergone longitudinal division parallel to the long axis of the anther. This hypodermal cell in which division occurs constitutes the *archesporium* of Goebel ††. The archesporium so divided consists, therefore, of an inner and an outer segment. The inner segment in each lobe is in reality the *primary mother cell of the pollen* (Pl. XVI. figs. 1 & 2, *p m c*). Each of the primary mother cells, as seen in transverse section, will be found, when viewed longitudinally, to correspond to a single longitudinal row of somewhat cubical cells, rather higher, however, than they are broad or long. Since only a single row of primary mother cells is formed in each lobe, the anther is bilocular from the beginning, and never at any period quadrilocular. The outer or more superficial segment of the primitive archesporial cell then becomes successively divided longitudinally in a tangential plane, in such a manner that in transverse section three layers of cells are now apparent. In these latter, radial, horizontal, and further tangential

* "Zur Entwickelungsgeschichte der *Zostera*," Bot. Zeit, 1852, No. 7. pp. 121–131, plate iii.

† Das Mikroskop, 2. Aufl. p. 166 *et seq.*

‡ Grundzüge der wissenschaftlichen Botanik, Leipsic, 1850.

§ Linnæa, iv. p. 94; also Trans. Roy. Acad. of Sciences, Berlin, Nov. 1831.

|| Linn. Trans. vol. xvi. p. 717 *et seq*, 1833.

¶ Ann. des Sci. Nat. Ser. i. vol. xxiv. pp. 263–279, pls. 13–14 B.

** De Pollinis Orchidearum Genesi ac Structura: Leipsic, 1852.

†† "Beiträge zur vergleichenden Entwickelungsgeschichte der Sporangien," Bot. Zeit. 1881.

divisions successively occur. The cell which constitutes the innermost of these three layers forms by radial division a peculiar epithelium of rectangular cells, investing on the inside the primary mother cell: this is the *tapetum* (Pl. XVI. figs. 2, 3, & 4, *tap*). The cells of the tapetum *proper* are reinforced by a corresponding layer on the external side of the anther-lobe, formed by means of a series of internal segments, cut off vertically from the cells of the parenchymatous ground tissue in that region (Pl. XVI. figs. 3–9, *tap**). In this manner a limiting membrane is formed, which entirely surrounds and invests on all sides the primary mother cell of the pollen.

The tapetal cells *proper* are thus derived from a portion of the primitive archesporium, while those cells by which the layer is completed towards the outer side of the anther, and which appear in transverse section to be longer and more oblong than the real tapetal cells, are not so derived. Each cell of the limiting membrane contains a prominent nucleus surrounded by granular protoplasm.

The primary mother cell of the pollen is, when viewed in transverse section, at first somewhat hexagonal in shape, single, and of relatively large size; for while the outer segment of the archesporial cell has continued to undergo division, no further division has taken place in the inner segment, which possesses very granular protoplasmic contents and a distinct nucleus (Pl. XVI. fig. 6, *m c*). Very soon, however, it may be found exhibiting two nuclei produced by the division of the single one; and this nuclear division is speedily followed by a division of the protoplasm into two portions, and formation of a longitudinal septum in a direction somewhat oblique to the surface of the anther. Each of these two cells now begins distinctly to elongate in a direction perpendicular to the surface of the anther; and by virtue of this elongation they become very sharply differentiated from the surrounding tissue. As the loculus expands by growth of its walls, this elongation becomes more and more pronounced. Immediately after this change has become fairly well marked, each of the two cells becomes divided by longitudinal division parallel to its longer axis; and this is followed by a transverse, *i. e.* horizontal division, also parallel to its longer axis, and therefore at right angles to the last. The cells, in consequence of this, take the form of short prisms, whose direction is inclined obliquely downwards from the surface (Pl. XVI. fig. 7). Of these prisms four appear in transverse section; and the free faces of the two lateral ones are somewhat rounded, so that the whole mass has now a slightly elliptic form. Further division of each of these prisms is then continued in both the longitudinal and horizontal planes parallel to the longer axis of the cell; the result of which is that the loculus of the anther now contains a large group of cells, comparatively narrow in proportion to their length, which appear in any transverse section as a single row, consisting of from eight to twelve or more cells. Seen in this view they are of extreme length, being six to ten times longer than they are broad, of large size, and rhomboidal or prismatic form, while they pursue a slightly oblique direction. Each possesses very granular protoplasmic contents, containing a large circular nucleus with a nucleolus, a large vacuole at each end, and a thin cellulose cell-wall. Their vertical or longitudinal walls form a common partition between these cells, on the one hand, and the cells of the tapetal limiting membrane, which closely surrounds them, on the other. Some of them may, at a slightly later period, be found exhibiting two nuclei in close proximity to each other. In longitudinal sections they may be seen to lie in numerous obliquely directed rows, arranged one above the other.

But all the narrow prismatic cells contained in a loculus remain parallel and closely appressed together, in close and intimate connexion one with another, so that they cannot be separated one from the other without injury and rupture; in the relative thickness of their walls, moreover, they present no difference which would enable one to assert with any degree of certainty, when this stage has been reached, that any special aggregation of cells was the direct derivative of one of the segments of the primitive mother cell. The coherent tissue completely filling the cavity of the loculus, and bounded by the tapetal membrane, has throughout thoroughly the appearance of a cell-mass all of whose cells have been repeatedly bisected in succession by a series of divisions in two planes only.

At this stage of their development they correspond exactly to the contents of a single loculus in the young anther of *Zostera*, a genus of Monocotyledons whose mode of pollen-formation has been studied in a most masterly manner by Hofmeister *. Indeed the earlier stages of *Asclepias* and those of the last-named genus exhibit an extremely close correspondence with one another, the only marked difference between the two cases being that in *Zostera* the anther is quadrilocular. My observations up to this point accord at first with the single recorded observation of Schacht, rather than with those of Hofmeister, though they commence at a much earlier stage than was noticed by either of these writers. Hofmeister regards the pollen as derived, not from a *single* primitive mother cell, as seen in transverse section, but from a *group* of primitive mother cells. Being unable to trace his "group" of cells back any further, he regards Schacht's statement and figure † that in *Asclepias* only a *single* primary mother cell is formed in each anther-lobe as erroneous. The ultimate conclusion reached, if his observations on this point be accepted, is, of course, a multicellular archesporium; while my own results distinctly prove that it is unicellular, and that Schacht's statement really represents the true condition of the case. Apart from this, however, I have been able completely to confirm Hofmeister's researches, in so far as they relate to the pollen-development of *Asclepias* up to the stage at which the most obvious resemblance to that of *Zostera* is exhibited.

The cell-walls of the primary mother cell and its derivatives by division are thin, and always remain so, never being visibly thickened at any subsequent period. In this feature they resemble, so far as is known, only *Zostera* and its near ally *Naias* ‡, while they differ in it from the rest of Angiosperms generally.

At this point, however, the close analogy to, and correspondence with, the type of pollen-formation in *Zostera* ends. In the latter the granular protoplasmic contents

* *Loc. cit.* pp. 125–128, plate iii. figs. 4–15 *b*; also Neue Beiträge, ii. pp. 643–645; also Johannes Grönland, "Beiträge zur Kenntniss der *Zostera marina*," Bot. Zeit. 1851, pp. 185–192, and plate iv.

† Das Microskop, pl. iii. fig. 8; English edition, 1853, p. 105, fig. 21 *a*.

‡ W. Hofmeister, Neue Beiträge zur Kenntniss der Embryobildung der Phanerogamen, part ii. Monokotyledonen, pp. 642, 643, plate i. figs. 1–12, 1859.

of each of these long, narrow, prismatic cells becomes surrounded by an exceedingly thin and delicate but readily observable cellulose membrane, and forms an elongated club-shaped or fusiform pollen-grain, exhibiting therefore perhaps the most primitive type of pollen-formation known in the Phanerogams. In *Asclepias*, on the contrary, further division of each of the prismatic cells takes place, resulting ultimately in the formation of the special mother cells of the pollen in the following manner:—

Succeeding the division of the nucleus of each of the prismatic cells into two parts (which feature, it has been already mentioned, was observable in some of the cells), the protoplasmic contents now divide vertically into two at right angles to the long axis of the cell, and therefore in the direction of the breadth of the anther, and at right angles to all the previous planes of division; simultaneously the formation of a cell-wall takes place in the plane of division, *i. e.* parallel to the short sides of the prism. By means of this septum the prismatic cell becomes divided into two smaller segments of oblong form and equal size *. The conspicuous nucleus of each of these oblong cells then becomes further subdivided by vertical division at right angles to the length of the cell. This division is followed by division of the protoplasm and formation of a cellulose septum running in the same plane.

The walls formed by the two last series of divisions are, of course, only visible in transverse sections. In the upper narrower part of the anther-lobe, the number of longitudinal divisions which the primary mother cell undergoes is very small; and in consequence of this, fewer long narrow prismatic cells are visible in a transverse section through this part. Further, in this portion, sometimes only one of the two oblong cells formed by vertical division of the narrow prism divides again vertically; so that in transverse section three cells only are apparent in an oblique row, viz. one larger and two slightly smaller. The cells formed by these successive vertical divisions of the narrow prisms, each with a conspicuous nucleus, are at first cubical; and in longitudinal section they are seen to be disposed in numerous more or less horizontal rows one above another. Soon, however, they become spherical in form (Pl. XVI. fig. 8), owing to the rounding-off of their walls on all sides, though they still remain firmly adherent together, and at the points where they touch adjoining cells there still exists only a common partition-wall. They are the *special mother cells of the pollen* (*s m c*, fig. 8). At this period the mass of granular protoplasm contained in each of them cannot be discovered to have any special cellulose coat or wall deposited on it, but is surrounded only by the wall of the special mother cell.

Thus none of the cell-walls so far produced in the whole course of the development of the pollen undergo absorption, as is commonly the case, and as Reichenbach has shown to take place in the waxy pollinia of the Orchids (where the mother cells are broken down, and form a viscid pulp in which the tetrads lie), but persist †—the cells which

* The effect of all these divisions in the primary mother cells is merely to increase the number of mother cells from which the special mother cells are subsequently to be derived.

† Schleiden (*loc. cit.*) states that the walls of the primary mother cells *are* absorbed in *Asclepias*, and that at a very early period. Such, however, is not the case. In *Naias*, according to Hofmeister, they are resolved together with those of the special mother cells.

they bound, though now become rounded, adhering, as has just been mentioned, closely to one another. Their contents also never become, now or subsequently, set free, except on the rupture and bursting of the pollinium. By the unequal extension of the whole loculus the special mother cells contained in it now become polyhedral (Pl. XVI. fig. 9). They are formed by division of the single primitive mother cell in three planes, at right angles to each other; but the succession of the divisions is quite unique, and is not that usually characteristic of Dicotyledons.

That vertical wall of each of the limiting tapetal cells which is adjacent to the special mother cells now undergoes, at least in part, conversion into cutin, and in so doing increases considerably in volume; the chemical change is likewise accompanied by a change in colour from colourless to pale yellow. This change is followed successively by a like conversion of all the walls surrounding the special mother cells, which assume the same tint. On treating these walls with concentrated sulphuric acid a pale ruby-red colour is produced in all alike.

In this manner the pollinium is produced; and it can at this period be extracted from the anther-loculus in the form of a single, definite, compact, solid, coherent mass, of considerable size, with a deep golden-yellow colour and a waxy look externally. Its surface, which is perfectly smooth, and not in the least viscid, as it is stated to be by Thomé, presents the appearance of being divided in a reticulate manner into areolæ or hexagonal meshes, the apparent bulging of each areola being caused by the shape of the underlying cell filled with protoplasm (Pl. XVI. fig. 10).

Each pollinium contains all the adherent or firmly united special mother cells produced in one anther-loculus or pollen-sac. In transverse section it exhibits a cellular appearance and structure, consisting of three series or rows of cells * parallel to its sides, the middle series being more or less interrupted. These cells are enclosed by thick pale yellow-coloured semitransparent cell-walls, the cell-walls of those belonging to the two outer rows being continuous at certain points with, and surrounded by, a deep-golden-yellow, pellucid, cuticularized membrane, which has a resistant horny texture, cuts with great ease, and is derived from the change of those portions of the surfaces of the tapetal cell-membranes immediately adjacent to the special mother-cells. This membrane, forming an unbroken sheet, encloses and envelops completely every part of the entire, compact, solid, concrete mass of coherent special mother cells filling the anther-loculi, thus forming a general coat of considerable thickness. Brongniart (*loc. cit.* p. 267) and Schleiden (‘Principles of Scientific Botany,’ ed. 3, 1849, p. 356) both believed that this yellow investing membrane, which I have shown to be formed from the tapetum, was itself really of a cellular nature, *i. e.* composed of cells; for the former observer tells us that the areolate appearance is due “not to the underlying cellular mass, but to the cells themselves which constitute the membrane, and which are disposed after the fashion of epidermal cells;” while the latter regards it as formed “of the outermost layer of the special mother cells in which no pollen-grains are developed.”

* In the oblique planes of the original prismatic mother cells, each row consists of four cells, not three. The relation of the descriptions framed from the two points of view, viz. perpendicular and oblique, is easily seen, however, on reference to the figures.

A very slight examination will easily afford convincing proof that both of these views are at variance with the facts.

No other observer, with the exception of Payer, has attempted to fathom the mode of origin of this membrane; and this observer held that the viscid gum forming the "appendages" or "processes" of the stigmatic corpusculum—which he believed was a liquid secreted by a gland (the corpusculum)—flowing in lateral channels or grooves, when it arrived at the anther-lobes on which the lateral grooves abut, penetrated into the interior of these lobes, and agglomerated the grains of pollen, uniting them afterwards through their whole extent (*vide* 'Traité d'Organogénie comparée de la Fleur,' vol. i. page 569). This same investigator did not examine the method of development of the pollinium by means of sections; or it would have been clearly evident to him that the investing membrane is formed and completed at a period long prior to the dehiscence of the walls of anther-loculi and consequent exposure of the pollinium, also that the only function performed by the corpuscular appendages, when the anther-loculi have opened by dehiscence, is that of firmly attaching the pollinia to their free ends, the substance of the two bodies, though externally united, being never confounded, but always remaining completely distinct, and moreover giving different reactions with micro-chemical reagents. Schacht believed (on what evidence he does not state) that the investing membrane was "of the nature of a secretion; and such is the view held by Prof. Oliver" *. But such is certainly not the case; and Dr. Maxwell T. Masters, in his article "Asclepiadeæ" †, hazards the statement that it is derived "from the separable inner lining of the anther-cell," probably referring to Brongniart's view above cited.

It is at once obvious that the pollen-grains subsequently formed in the special mother cells so enclosed cannot be dispersed in the ordinary way; nor can the pollinia fall out of the open anthers spontaneously, but remain seated there undisturbed, so that pollination without foreign aid is impossible; and, moreover, the flower is so very peculiarly contrived and adapted for the visits of insects in search of honey, that the pollinia are by their agency extracted and removed *en masse* from their place of origin, and applied by the same medium to a distant part of another flower.

Each special mother cell contains within its cuticularized wall a mass of protoplasmic contents, which have assumed a frothy condition owing to the presence of a number of vacuoles or oil-drops.

In this protoplasm spherical granules are to be met with in considerable numbers, and a distinct nucleus may be detected.

Very soon, however, by the aid of reagents, especially the aniline colour methyline-blue ‡, a delicate thin transparent hyaline membrane or wall (in fig. 11) is found to clothe and to have been formed all over its surface by the protoplasm, which has in some cases,

* 'Lessons in Elementary Botany,' p. 216.

† Lindley and Moore's 'Treasury of Botany.'

‡ I owe the suggestion that I should make use of this staining reagent to my friend Mr. W. Gardiner, who has employed it largely in his researches on "the Continuity of the Protoplasm in the Motile Organs of Leaves," Proceed. Camb. Phil. Soc. vol. iv. pt. v. pp. 266–271; also Quart. Journ. Mic. Sci. N. S. vol. xxii. no. lxxxviii. Oct. 1882, pp. 365, 366.

where the preparation has been treated with alcohol, slightly contracted away from this wall. The membrane, however, is exceedingly difficult to detect at this stage. This change takes place simultaneously in all the special mother cells. The newly formed cell, consisting of a very thin and delicate cellulose wall, closely applied to the internal side of the pale-yellow cuticularized wall of the special mother cell by which it is surrounded, but from which it may be made to contract away by means of alcohol, enclosing protoplasm loaded with vacuoles and rendered dark with minute granules and a nucleus, is the equivalent of the pollen-grain of other plants, and, to indicate this feature, is here designated by the same title.

The mode of formation of the pollen, then, in *Asclepias* is very different from that which is the characteristic and prevalent type in the majority of Dicotyledons or Monocotyledons, and, so far as our present knowledge extends, exhibits in its *entire* details a perfectly unique, isolated, and peculiar case of development. The earlier stages are only to be found paralleled in the single instance of *Zostera*, which affords either the most primitive or most aberrant type of pollen-formation known. The later stages find no precise parallel in the entire range of the vegetable kingdom. This is the more remarkable, since another member of the Asclepiadeæ, viz. *Periploca græca*, exhibits, according to Reichenbach, a type of pollen-formation exactly comparable to that of the Orchid genera *Neottia* and *Epipactis* *.

Observations on the mode of development of the pollen in *Asclepias* are fraught with extreme difficulty; and its history can only be revealed by careful study of extremely thin transverse and longitudinal sections.

In many of the pollen-grains, especially when the flower was fully mature, I was able, by careful observation, and by having recourse to osmic acid of one per cent. strength, and to staining reagents—such, *e. g.*, as hæmatoxylon, Grenicher's carmine, and some of the aniline colours, viz. gentian-violet, saffranin, and methyl-green, to the latter of which a few drops of solution of acetic acid, one per cent. strength, had been previously added—to detect not a single nucleus only, but two nuclei, one of which was invariably larger than the other.

The smaller nucleus was often found lying close to the cell-wall; and in these cases I believe that, surrounded by a small quantity of protoplasm, it is cut off from the rest of the grain by a cellulose wall, although I was not always able to show this satisfactorily. This discovery is especially of interest in connexion with the recent researches of Elfving † and Strasburger ‡, since further confirmation of their observations has thereby been obtained in the pollen-grains of plants which they did not investigate, and in

* Dr. S. H. Vines suggests that probably in *Asclepias* and likewise in *Zostera* the phase of the special mother cells, as it occurs in other plants, is omitted, and hence we get the departure from the normal types. On this view, what I have termed the special mother cells are really the last series of the mother cells produced by repeated division of the single primary one.

† Jenaische Zeitschrift für Naturwissenschaft, 1879, part i., and Quarterly Journal of Microscopical Science, N. S. vol. xx. 1880, pp. 19–35.

‡ "Ueber Befruchtung und Zelltheilung," Jenaische Zeitschrift für Naturwissenschaft, Bd. xi.; (neue Folge, Bd. iv.) 1877, Heft iv. page 450.

which the very presence of nuclei of any kind whatever had not been previously detected.

I consider the smaller nucleus of the Asclepiad pollen-grain to be the representative of what Elfving terms the "vegetative nucleus," and others have designated as the "passive nucleus," which nucleus is genetically the last remnant of the male prothallium of a vascular Cryptogam type, such as *Equisetum*, while the larger nucleus, equivalent to the "active nucleus," is genetically the last remnant of the antheridium of such a type.

In shape the pollen-grains are always nearly spherical, though usually slightly angular, so as to be really irregularly polyhedral (Pl. XVI. fig. 11); their membrane is, as previously stated, single, very thin at first, ultimately becoming thicker, smooth, hyaline, and transparent, and formed of unchanged cellulose. There is at this stage no appearance whatever of the tubes which are afterwards produced.

Strasburger, in his most recently published work *, mentions the fact that he has observed the presence of only a single coat in the pollen-grains of the following plants —*Gaura biennis*, L., *Clarkia elegans*, Dougl., *Senecio vulgaris*, L., *Cobæa scandens*, Cav., *Allium*, L., *Naias major* ? †, and Orchids; and the same phenomenon was first described by Fritszche ‡, and has long been known to occur in *Zostera*, L., while *Asclepias Cornuti*, Decaisne, must now be added to this interesting list of exceptions to what is otherwise the universal rule among phanerogamous plants.

The ultimate changes and fate which the tapetal membrane undergoes appear to be as follows:—The cells composing it which lie on the outer side of the anther divide each by means of a vertical tangential wall, parallel to the original tangential walls of the cell, so that the membrane becomes two cells broad on this side. Those tangential walls which are furthest from the pollinium in that row of limiting cells which is next the cavity of the loculus, together with the adjacent portions of the radial walls of these cells, become broken down and disintegrated. The tangential walls, on the other hand, which are nearest the pollinium, together with the internal portions of the said radial walls, persist for some time, forming a continuous membrane, surrounded by a layer of small cells. These latter, on the outer side of the anther, are segments from those cells which completed the tapetum *proper* on this aspect, and were themselves derived from the parenchyma, while on the inner side of the anther they constitute simply that row of cells which were formed immediately external to the tapetum *proper*, at the same time that it was differentiated, and which have persisted. Such is the condition immediately prior to the opening of the two anther-loculi to expose the pollinia. The mode in which the dehiscence of the anther takes place will be fully described in a subsequent paper, the result being that the whole of the

* Ueber den Bau und das Wachsthum der Zellhäute: Jena, 1882.

† Hofmeister (Neue Beiträge, 1859, part ii.) describes the existence of "a very thin but distinct extine" in the pollen-grains of this species; but in his figure (pl. i. fig. 11) he represents this extine as extending with the intine along the pollen-tube produced from the grain! It is therefore highly probable that Strasburger's observation is more accurate.

‡ "Ueber den Pollen," Mémoire présenté à l'Académie Impériale de St. Pétersbourg, iii. 1837.

tapetal membrane, together with a large portion of the substance of the anther, is broken down and disintegrated. The comparatively late period to which the tapetal membrane persists in *Asclepias* is a noteworthy point; in other Dicotyledons it usually breaks down, in consequence of the growth of the pollen-grains, *immediately after* the absorption of the walls of their special mother cells, while in the group of Monocotyledons it becomes either diffluent or absorbed at an early period, and the mother cells themselves in consequence float freely about in the loculus quite separate from one another.

Asclepias therefore appears to present at first sight a closer analogy in the period of resolution of its tapetum to the Monocotyledons than to the group of which it is a member, since the pollinium, which consists, among other parts, of the persistent though altered walls of the mother cells, comes ultimately to lie in the cavity formed by its resolution. Inasmuch, however, as the period of its resolution is coincident with that of the dehiscence of the anther-loculus, I believe that it more closely approaches the type of the group to which it really belongs than that of the Monocotyledons, though it differs from both, so far as we know of them at present.

DESCRIPTION OF THE PLATE.

Plate XVI.

Development of the Pollinium.

Fig. 1. Very early stage of one half of an anther, seen in transverse section, showing division of the single archesporial cell into inner and outer segments, the former, which alone is shaded, constituting the primary mother cell of the pollen, *p m c*; *z*, the outer segment; *epi*, the epidermis covering the anther; *par*, ground-tissue of the anther. The fibro-vascular bundle of the connective is not yet visible.

2. A slightly later stage, also seen in transverse section. The primary mother cell, *p m c* (alone shaded), has now longitudinally divided into two mother cells. The outer segment, *z*, of the previous stage, has divided tangentially into three rows of cells, and these, again, vertically. The innermost row of these adjacent to the primary mother cell is the tapetum *proper*, *tap*.

3. A later stage. The two mother cells of the previous stage have now divided each in a longitudinal plane, so that four mother cells, *m c*, are seen; *tap*, tapetum *proper*; *tap**, segments cut off from the surrounding parenchyma, by which the tapetum is completed on the external side. The hypodermal layer of the previous stage, formed from *z*, has now become divided into two by longitudinal division.

4. Later still. The mother cells, *m c*, have become more numerous by longitudinal division of each of the four seen in the previous stage into two; and they have at the same time become longer. At this stage the contents of the loculus very closely resemble those of *Zostera* immediately before the formation of the pollen-grains. The other parts as before. The fibro-vascular bundle of the connective, *v*, has become visible a little before this stage.

5. Longitudinal section of an anther-lobe when the stage represented in the last figure (fig. 4) has been reached. The parts are lettered as in the previous figures.

Fig. 6. A stage still later. The mother cells, *m c*, of the last stage have each divided longitudinally into two in a plane at right angles to their length, so that they now form two rows; the other parts are lettered as before; *con*, the connective tissue.

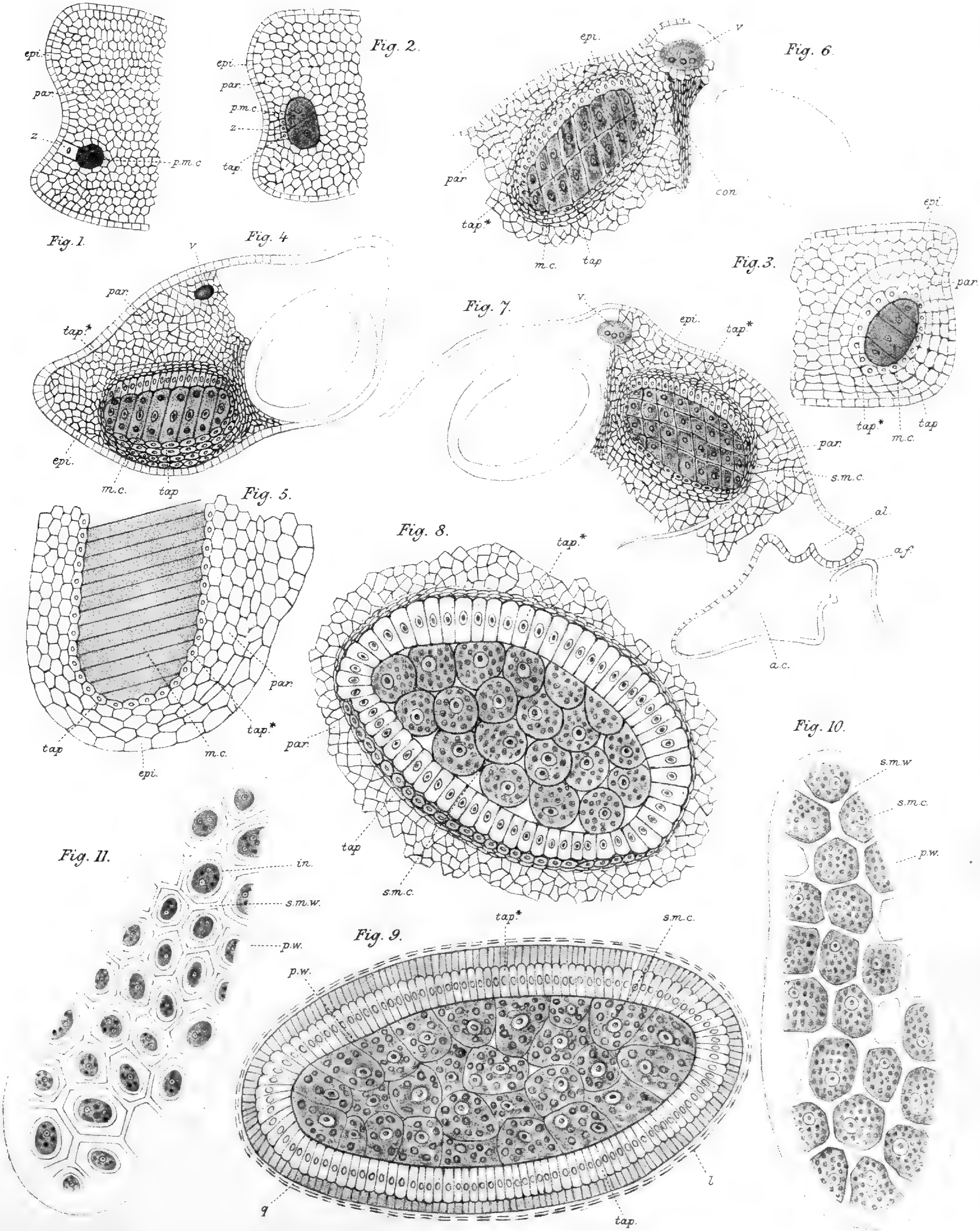
7. Still more advanced. Each mother cell has again divided longitudinally into two in a plane at right angles to its length, so that from each mother cell a row of four cubical cells has been derived; these are the special mother cells of the pollen, *s m c*. The other parts are denoted by the same lettering as in the previous figures.

8. Portion of an anther seen in transverse section at a later period, the parts named as in the last figure. The special mother cells have now become rounded, but are still connected with one another. Considerable changes have taken place in the cells immediately external to those, *tap*, *tap**, which form together the limiting tapetal membrane; the walls of the former are much compressed, and the cell-cavity in some cases is almost obliterated.

9. The same at a more advanced stage still. The tapetal cells, *tap**, have become divided to form two layers; the wall of each of the tapetal cells, *tap*, *tap**, which is adjacent to the special mother cells has become in part cuticularized; and this transformed portion forms a continuous sheet of a pale yellow colour, *p w*, enclosing the whole of the special mother cells, *s m c*, the cell-walls of which are still unchanged. This sheet forms the external coat of the pollinium; *l*, compressed remnants of the rows of cells external to the tapetal membrane in earlier stages; *q*, the row of cells originally internal to the single row of tapetal cells proper which has persisted.

10. Transverse section of a nearly adult pollinium removed from the anther-loculus: *p w*, external cutin coat of the pollinium; *s m c*, special mother cells, now become polyhedral, whose walls, *s m w*, have likewise become cuticularized.

11. Fully adult pollinium, seen in transverse section. The contents of each of the special mother cells have contracted slightly from its cutin wall, and formed over the whole surface a thin, delicate, cellulose membrane, *in* ("intine"), thus becoming converted into a pollen-grain. The section has been treated with absolute alcohol, so that the contents have contracted away from the newly formed wall, *in*, which is then rendered evident by staining with methyline blue. Several of the pollen-grains are seen exhibiting two nuclei.



H.M.C. et T.H.C. del. ad nat.

DEVELOPMENT POLLINIUM OF ASCLEPIAS CORNUTI

F. Huth, Lith^r Edin^r

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Part	VII. 1878.	1	16	0	1	7	0
Part	VIII. 1879.	1	0	0	0	15	0
II. Part	I. 1879.	1	4	0	0	18	0
Part	II. 1881.	0	15	0	0	11	6
Part	III. 1882.	1	8	0	1	1	0
Part	IV. 1882.	0	7	6	0	5	6
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Part	IV. 1876.	0	10	0	0	7	6
Part	V. 1878.	1	4	0	0	18	0
Part	VI. 1879.	1	6	0	0	19	6
Part	VII. 1880.	1	4	0	0	18	0
Part	VIII. 1880.	1	1	0	0	16	0
Part	IX. 1880.	1	0	0	0	15	0
II. Part	I. 1881.	0	12	0	0	9	0
Part	II. 1882.	0	5	0	0	3	9

2nd Ser. BOTANY.] [VOL. II. PART 3.

THE

TRANSACTIONS

OF

THE LINNEAN SOCIETY OF LONDON.

LIST OF FUNGI FROM BRISBANE, QUEENSLAND;

WITH

DESCRIPTIONS OF NEW SPECIES.—PART II.

BY

The Rev. M. J. BERKELEY, M.A., F.R.S., F.L.S., & C. E. BROOME, M.A., F.L.S.

NATURÆ DISCERE MORES

LONDON:

PRINTED FOR THE LINNEAN SOCIETY

BY TAYLOR AND FRANCIS, RED LION COURT, FLEET STREET:

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March 1883.

VI. *On a New Species of* Cycas *from Southern India.* *By* W. T. Thiselton Dyer, *M.A., C.M.G., F.R.S.*

(Plate XVII.)

Read May 3rd, 1883.

THE discovery of a new species belonging to the *Cycadeæ* is always a notable fact, and in this case it is the more interesting as the Indian peninsula has always been regarded as, at the best, poorly furnished with representatives of Gymnosperms.

Southern India appears to possess three species of the genus *Cycas*. *C. circinalis*, L., is well known as a native of Malabar. *C. squamosa*, Lodd., is probably distinct; but it is at present very imperfectly known. I have given its horticultural history, as far as I have been able to make it out, in the 'Gardeners' Chronicle' for August 27, 1881. Besides these, Colonel Beddome has mentioned in his 'Forester's Manual of Botany for Southern India' (p. ccxxvii), a third. I will quote his words :—

"A .... species, which I take to be *C. revoluta*, is common on the Cuddapah and other hills on the east side of the Presidency; its leaflets are very narrow, with revolute margins, and the costa not prominent and raised beneath. I have, however, never seen it in flower."

The native country of *Cycas revoluta*, if not some of the Japanese islands, is almost certainly in Eastern Asia; and it seemed exceedingly unlikely that Colonel Beddome's plant could be that species. Not having seen a specimen, I applied to him for one; and this he very kindly furnished me with from his own herbarium. It consisted merely of a frond; but this appeared to me to be in many respects quite distinct from *C. revoluta.*

I was anxious to obtain plants for cultivation, as well as the male and female inflorescences. For copious examples of all of these I have to thank H. H. Yarde, Esq., the Deputy Conservator of Forests, Cuddapah division. From the material so obtained the plate and the following description have been prepared.

The species is so distinct in habit that it is difficult to indicate its relationship; but on the whole it appears to me that it might be regarded as a very reduced form of *C. circinalis*, its Malabar congener, though differing from it in many striking particulars.

Cycas Beddomei, Dyer, sp. nov.; foliorum segmentis numerosissimis linearibus spinoso-acuminatis margine revolutis, infimis abbreviatis ad spinulas repente reductis, petiolo versus basim inermi, strobilo masculo oblongo-ovoideo subsessili, squamis e basi obovato-deltoidea longe acuminatis primum fusco-pubescentibus deinde glabrescentibus basi strobili rectis deinde apicem versus valde deflexis, carpophyllis ferrugineo-pubescentibus longe lingulatis supra medium 4 semina gerentibus in laminam ovato-lanceolatam longe acuminatam dentato-lobatam desinentibus, senioribus glabris.

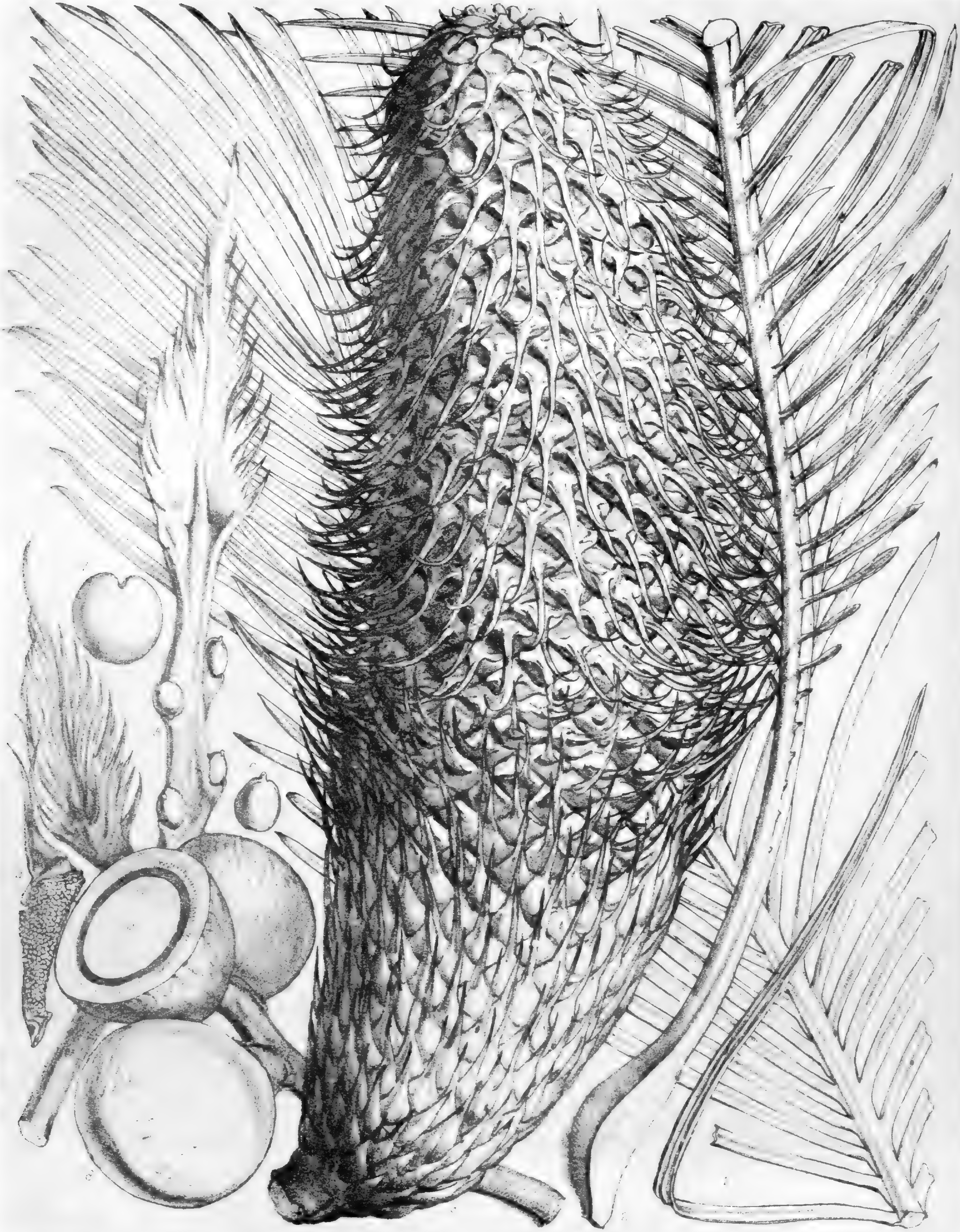
The only stems I have seen are small, not more than a few inches high, and clothed with the glabrescent closely imbricated leaf-bases. Leaves about 3 feet long, 9 in. broad; rhachis subquadrangular; petiole about 6 in. long, strongly 4-angled, the upper third furnished with a few minute teeth, the base clothed with a tufted tomentum; leaf-segments strongly revolute, about $\frac{1}{8}$ in. wide. Male cone about 13 in. long, 3 in. in diam., slightly stipitate; scales tapering acuminate from an oblong-deltoid base, erect at the base of the cone, strongly deflexed in the upper half or two thirds. Carpophylls 6-8 in. long, bearing 4 ovules above the middle; lamina about 3 in. long, 1 in. broad, ovate-lanceolate, with a long acuminate point; margin deeply laciniate, segments tapering into aculeate spines, seeds globose, $1\frac{1}{2}$ in. in diameter, sometimes slightly compressed.

DESCRIPTION OF THE PLATE.

Plate XVII.

Cycas Beddomei, Dyer, n. sp.

Fig. 1, upper part of frond; 2, lower part of same; 3, male cone; 4, antheriferous scale of male cone; 5, carpophyll with ovules; 6 & 7, ovules in different stages of growth; 8, carpophyll with mature seeds, all of natural size.



CYCAS BEDDOMEI. *Dyer n. sp.*

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II. Part I.	1879	1 4 0	0 18 0
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Part V.	1878	1 4 0	0 18 0
Part VI.	1879	1 6 0	0 19 6
Part VII.	1880	1 4 0	0 18 0
Part VIII.	1880	1 1 0	0 16 0
Part IX.	1880	1 0 0	0 15 0
II. Part I.	1881	0 12 0	0 9 0
Part II.	1882	0 5 0	0 3 9
Part III.	1883	0 10 0	0 7 6
Part IV.	1883	0 3 0	0 2 3
Part V.	1883	0 3 0	0 2 3

2nd Ser. BOTANY.] [VOL. II. PART 6.

THE TRANSACTIONS OF THE LINNEAN SOCIETY OF LONDON.

STRUCTURE, DEVELOPMENT, AND LIFE-HISTORY OF A TROPICAL EPIPHYLLOUS LICHEN (STRIGULA COMPLANATA, Fée).

BY

H. MARSHALL WARD, B.A.,

LATE CRYPTOGAMIST TO THE GOVERNMENT IN CEYLON.

(*Communicated by* W. T. Thiselton Dyer, C.M.G., F.R.S., F.L.S.)

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January 1884.

VII. *On the Structure, Development, and Life-history of a Tropical Epiphyllous Lichen* (Strigula complanata, *Fée, fide Rev. J. M. Crombie*). *By* H. MARSHALL WARD, *B.A., Berkeley Fellow of Owens College, late Cryptogamist to the Government in Ceylon.* (*Communicated by* W. T. THISELTON DYER, *C.M.G., F.R.S., F.L.S., Assistant Director, Royal Gardens, Kew.*)

(Plates XVIII.–XXI.)

Read February 1st, 1883.

MANY of the facts enumerated in this paper had been already discovered when a paper by Mr. D. D. Cunningham on *Mycoidea parasitica* (Linn. Trans. Bot. i. part vi. January 1879) reached me. Full justice is done to this admirable memoir at the end of the present paper.

Almost from the moment of my arrival in Ceylon in the spring of 1880, my attention was attracted by the forms of Lichens so common on the upper surfaces of many leaves and flourishing in the warm damp atmosphere of that part of the island in which I resided for nearly two years. At such times as could be spared from other work, I endeavoured to form some idea of these organisms as a group, and slowly arrived at the conclusion that among numerous examples, provisionally regarded as different species, relations exist which compel one to consider many of them as stages in the development of a few forms.

Few botanists, probably, would regard the accident of habitat of "Epiphyllous" Lichens as of more value than that of "Saxicolous," "Corticolous" Lichens &c.; and I shall not, therefore, insist further on the more or less self-evident truth that no sharp line is to be drawn between these forms on this account. Nevertheless, while admitting that this is the case, it is not implied that the tropical Epiphyllous Lichens are necessarily to be distributed among known genera, a point only to be decided by research, and a matter of little importance to the purpose of this paper.

Since it will be eventually shown, however, that all the facts of structure and development of the epiphyllous cryptogam immediately concerning us support the view that a Lichen is a compound organism, compounded of an Alga on which an ascomycetous Fungus has become more or less intimately affixed and dependent, it may be worth while to remove any superficial objections to classifying these organisms with other Lichens; and this will be more thoroughly dealt with as we proceed.

The organism to be described occurs on the upper surface of the leaves of so many plants widely separated in affinity and origin, that one must regard the species of the supporting plant as an accident. One general feature, however, is common to all these leaves: they are invariably hard and persistent, differing moreover in degree in this respect. I have specially observed this organism on the leaves of *Coffea liberica, Ixora,* *Thea*, *Memecylon*, *Eugenia*, *Anona*, *Elæagnus*, *Magnolia*, *Citrus*, *Durio*, *Sideroxylon*, *Quassia*, and *Michelia*. On several trees of the latter genus (*Michelia fuscata*), growing in the garden near my residence, the lichen was so regularly and abundantly developed that excellent opportunity and materials for the research were continuously present.

The details to follow, therefore, are particularly true for this form, and must be held to apply generally to the specimens obtained from the other plants. I have been able to detect few differences (none of importance) in the other forms mentioned, and shall refer to such as are known as we proceed.

Fig. 1 *, Pl. XVIII., is an excellent representation of a twig of *Michelia*, the leaves of which are affected with the epiphyllous lichen in all stages of development. Careful examination of the various-sized spots and blotches enables one to distinguish about four types, differing chiefly in colour and consistency. These are, taken in proper (*i. e.* developmental) order of sequence :—(1) orange-red circular or stellate patches; (2) green or grey-green blotches; (3) whitish or grey spots; and (4) glistening white shining circles, or irregularly branched groups. All these types pass by imperceptible gradations one into another; and any one may vary in size from a mere point to a disk a quarter of an inch or even more in diameter. For the sake of simplicity and clearness, I shall describe the phenomena in genetic order as far as possible, and not in the sequence of their discovery.

If a leaf, such as the upper one in fig. 1, be carefully observed during several weeks, it becomes clearly demonstrated that the orange-red and green types of the spots, of all sizes and shapes, pass over into the grey and white types; in other words, the red and green spots or blotches are earlier stages of the glistening white one, which is the complete Lichen (Pl. XVIII. fig. 3). As will be described later on, these changes may occur slowly or more rapidly, according to circumstances; hence the variations in size and form attained by any one stage prior to its passing into the succeeding condition.

If the spots of fig. 1 be slightly magnified, one discovers that the orange-red patches consist of delicate branched or rounded cushions, of soft texture, and studded, more or less profusely, with radiating filaments of exquisite beauty (fig. 2). The greenish and grey types, similarly enlarged, present equally various outlines; but the filaments and orange-red tint have here disappeared, and crowds of minute black dots are embedded in the greenish-grey matrix or cushion. When the complete lichen (fig. 3) is closely examined, it appears to consist of a dense, opaque, white ground-substance, shining with a glistening lustre, almost like porcelain, in which are embedded crowds of black dots as before, together with a smaller number of larger black or brown bosses. As already said, any of these types may vary in size, and may be circular, stellate, or irregularly branched in outline.

I may anticipate matters so far as to say that the orange-red early stage (fig. 2) is an Alga, of which the radiating filaments are in part reproductive organs, in part barren hairs; that this passes over into the green and grey stages, the orange-red cell-contents becoming simultaneously changed in many cases to chlorophyll-green masses, while certain modifications of growth &c. are induced by the invasion of a definite Fungus-

* This excellent drawing was made by Mr. W. De Alwis, the artist at Peradeniya; and I take this opportunity of thanking him for the care bestowed on it.

mycelium, and that the porcellaneous white matrix of the complete lichen consists of the same Algal thallus completely invested by dense masses of the Fungus-hyphæ, which in turn produce their fruit-bodies as the shining black dots above referred to. The grey-green stage is particularly interesting, as it allows both Alga and Fungus to be observed in vigorous conflict (Pl. XVIII. fig. 4 &c.). Having premised this, it will be convenient to describe in order the Alga, the Fungus, and the Lichen.

The Alga.

If a specimen of the orange-red spots be removed with a razor from the upper side of the leaf of *Michelia*, and magnified 30 or 40 diameters, it is found to consist of a discoid, lobed, or branched *thallus*, formed of cells symmetrically arranged in rows, radiating from one or more centres to the periphery of the disk or its lobes (Pl. XVIII. figs. 2 & 5; Pl. XIX. fig. 16, and Pl. XX. fig. 39). The structure calls to mind that of the thallus of *Coleochæte* ("*Phycopeltis*," "*Phyllactidium*" &c.), and, as will appear shortly, is essentially similar in character, mode of growth, &c.*

In fig. 5 *a* is drawn a portion of a terminal lobe of the thallus, seen from above by transmitted light; and at *c* the radial arrangement of the closely appressed cells is rendered quite evident. This arrangement results from the apparently dichotomous mode of division of the cells as the periphery of the thallus advances and extends itself (*cf.* also Pl. XX. fig. 40). Each vegetative cell of the thallus is found to consist of a firm cellulose wall, enclosing abundance of cell-sap (in which granules and oily particles may be floating), and a mass of protoplasmic and fatty contents, some of which are soluble in alcohol and ether. These may be coarsely granular, with large, orange-red, oily drops scattered throughout; or a finely granular or cloudy green matrix may contain a more or less sharply defined sphere of orange-red and coarse-grained bodies (figs. 5 & 6). In the latter case the fine-grained matrix is distinctly tinged with an apple-green diffused colouring-matter, resembling chlorophyll, and no doubt consisting of that substance. On adding potassic hydrate, the (now yellowish) matrix may become more evident. The relative proportions of this green substance and the red oil globules in the cells, determine the general hue of the thallus (*cf.* Pl. XVIII. figs. 4, 5, 6, Pl. XIX. fig. 12, Pl. XX. fig. 42, &c.); and it appears certain that the two colouring-matters are convertible one into the other, much as the red and green colouring matter in *Euglena*, *Protococcus*, &c.

Such cells always contain abundance of starch; and a vigorous thallus, such as is being described, becomes coloured with a deep indigo-blue tinge in most parts when iodine is added. No definite starch-granules could be discovered; and even the orange-red or yellow oily-looking masses absorb the iodine and become blue-black. Not only in these thallus-cells, but also in the hairs and zoospores to be described, does this reaction occur.

I have not succeeded in discovering an undoubted nucleus in any of these cells. The red spheres (figs. 5 & 6) often found are aggregations of oily drops and protoplasm, containing starch and other substances, and cannot be regarded as in any way of the nature of nuclei.

* Points of analogy with the *Chroolepideæ* will be discussed later.

Besides the plate of nearly equal thin-walled elongated cells, forming the main body of the thallus, there are to be observed certain structures developed from the surfaces, which may be conveniently regarded as appendages of the nature (morphologically) of *trichomes*. These are cellular outgrowths, differing in size, shape, contents, and functions, each of which must be looked upon as a modification of the ordinary thallus-cell. They are either simple enlargements of single cells, the contents of which pass over into zoospore-like motile bodies; or they are prolongations downwards, fastening the thallus to its substratum, like the rhizines in ordinary Lichens, or stiff processes projecting outwards and upwards as free "hairs." Certain modified forms of the latter also subserve reproduction.

The downward prolongations, or *rhizoids* *, as they may be conveniently termed, are simple outgrowths of individual thallus-cells, which become interposed between the thallus-plate and its substratum, growing irregularly, but chiefly along the plane of the epidermis, and branching like very simple lobes of the Alga. If a flourishing thallus be carefully removed by insinuating the blade of a thin razor between it and the surface of the leaf, the *rhizoids* may be distinguished, on looking at the lower surface of the thallus under the microscope, as a series of sinuous, often compressed, irregularly ramifying, few-celled processes, at a focus higher than that in which the body of the thallus is distinct (Pl. XIX. figs. 17 & 18). Each of these outgrowths is a diverticulum from the lower wall of a thallus-cell (fig. 12). If, after removing as above, the epidermis on which the *rhizoids* were spread be now observed, the outlines of these may be seen, as if imprinted as a pattern on the cuticle of the leaf. This is an expression of the fact that the rhizoids cling quite close to the cuticle, their walls becoming fused more or less completely with its substance—a process which is carried even further in some cases, as on *Citrus*-leaves, described below. As a rule, the rhizoids contain the pale, diffused, chlorophyll-like colouring matter, and few orange-red globules but no nucleus; sometimes, however, especially in an older thallus, the rhizoids are filled with orange-red globules, or become colourless, and are so closely fused with the epidermis below that they cannot be separated without rupture. They may, apparently, be produced from any cell of the thallus, but, though crowded in some cases, may be considerably scattered in others. It is not common to find the rhizoids developed from the walls of the cells containing the zoospore-like bodies; but even this occurs, as shown in Pl. XIX. fig. 19 *a*, where three short rhizoids have been produced by such a cell, or its immediate neighbour, and are closely applied to the cell-wall. In no instance have I observed any of these outgrowths piercing the epidermis of the leaf on which the thallus vegetates.

At fig. 19 is a carefully drawn example of such a rhizoid as developed from a marginal cell; its walls (as also the external walls of the cells at the edge of the thallus) are thickened as by a cuticular and striated increase of their substance. This example paves the way for the consideration of the processes sent forth by the thallus-cells into the air, and which may be called *trichomes*, or simply hairs.

If the thallus be examined by means of vertical sections taken through the whole leaf

* Since these anchoring bodies belong to the Alga alone, they may be more accurately compared to the processes at the base of *Œdogonium*, *Bulbochæte*, &c.

at the affected area, the rhizoids described above may be distinctly seen creeping on the surface of the substratum, and more or less compressed between it and the thallus whence they arise (*cf.* Pl. XVIII. figs. 8, 9, & Pl. XIX. figs. 12, 11). Since, as the examination of the under side of the thallus *en face* proves, these rhizoids take a sinuous course, they appear cut in all kinds of sections, transverse and oblique to their long axes. In some cases (fig. 12) loosely creeping on the cuticle of the leaf, in others they are more or less intimately blended with or even sunk into its substance (fig. 8), as if they had partially eaten a way in.

In a young thallus, the outer surface generally presents an unbroken outline; but at an early date in the process of development, the outer or upper walls of certain cells become bulged out, and grow forth as tubular outgrowths. These, like the rhizoids above described, usually became cut into several successive chambers by transverse septa; but instead of remaining thin-walled, and describing the sinuous courses of the rhizoids, they project stiffly from the edges and surface of the thallus, and form short or long, simple or multicellular hairs. Some remain parallel to the leaf-surface, and, except that their walls are thicker and their long axes straight, resemble the rhizoids; the others stand forth free into the air (*cf.* Pl. XVIII. figs. 5, 7; Pl. XIX. figs. 15, 16, &c.), at various angles from the surface of the leaf.

The marginal " hairs " commonly remain short and simple, or become divided by one or two cross walls into two or three chambers (fig. 5): the walls are smooth, and somewhat thick and firm, especially at the bluntly produced apex. The contents of their cells are, as before, granules and orange-red fatty matters, enclosed in a protoplasmic basis tinged more or less with pale apple-green. Under certain conditions the red matter is in abeyance, and the green colour predominates. As before, and as in the other hairs described below, every cell is usually abundantly supplied with starchy contents, striking a deep indigo-blue with iodine.

Those hairs which stand stiffly upright are longer, with few chambers and cross walls, and generally very brightly coloured by the orange-red oil-and-starch-containing substances; they are chiefly of two kinds, differing in structure and functions. First may be mentioned pointed, stiff, but slender outgrowths, differing but little, except in length, from the marginal hairs already described (figs. 5 & 16); second, equally long or longer, ascending, multicellular hairs, with the basal walls much thickened, and the apex developing into a swollen body, whence originate several radiating, short, tubular branches, each of which eventually produces an oval body, the contents of which pass over into zoospores (Pl. XIX. figs. 15, 21, & Pl. XX. fig. 24). I may, in order to avoid introducing any special terms for these bodies and the trichomes producing them, speak of the two kinds of hairs just described as simply " barren hairs " and " fertile hairs " respectively.

Before concluding this account of the purely vegetative system of the Alga, it may be well to describe the manner of growth of the thallus from its early stages. The cellular plate forming this originates as a spherical cell of the simplest description—a zoospore, in fact, which has come to rest on the bedewed surface of the leaf. This sphere is at first pale apple-green, and possesses a very delicate limiting membrane. In the pale-green matrix may be many or few orange-red oily drops, or granules; and starchy matter appears to be always present. In some cases, at least (Pl. XX. fig. 37), a scarcely perceptible, cloudy nucleus-like body appears; but I am by no means convinced that this is a distinct nucleus *. Some of the spheres appear orange-red from the first, on account of the large quantity of colouring oily matters present. Whether solution and formation of these matters, and consequent preponderance of green or red, follow a definite course in these earliest stages, I have been unable to decide.

This spherical mass of protoplasm becomes closely attached to the cuticle of the leaf, and soon becomes divided by about two or three division-walls into a few segments of equal or nearly equal volume. This primary process of division appears, in typical cases, to occur as follows:—three or four pale slit-like tracts or lines appear in the green- or orange-coloured groundwork (Pl. XX. & XXI. figs. 48 & 50), arranged in a star, and radiating from the centre; at first each of these pale lines appears isolated in the protoplasm; but their ends become at length united in the centre, and before long also cut the circumference of the mass. I have failed to prove that these first minute division-walls consist of diffluent cellulose; but since the cell-walls produced later consist of this substance, it appears highly probable. If the three or four radial slit-like tracts are the expressions of so many "cell-plates"†, as I believe to be the case, the primary process of division of this body becomes intelligible. Unfortunately, I have not been able to determine this point satisfactorily, or the exact relation of the nucleus-like body to the division-process. If we have a nucleus in this early stage, the primary division might be simply one of tetrahedral segmentation, one of the tetrads suffering no further division.

Be this as it may, the divisions immediately following are simple enough. The triply or quadruply segmented body is now a disk, closely flattened to the cuticle of the leaf. Each of the segments becomes again bisected, or nearly so, by walls radiating from the central to the peripheral regions (figs. 49 & 51); and as the new segments increase in size and the margin of the disk becomes extended, other radial walls follow, and a regular disk of larger size, and consisting of twice as many segments, is produced. After a number of radial walls have thus appeared, one or two tangential septa are formed across the older cells or segments; and these processes are repeated indefinitely. The diagrams (fig. 53) may serve to make these points clearer.

It will be evident that the disk, or young thallus, here follows the law of growth known as "dichotomous," though slightly modified ‡. Each radial row becomes more divided, as it lengthens, by tangential walls; and each marginal cell, as it widens, becomes bisected, as a rule, by a radial wall. In accordance with this arrangment and mode of growth, each cell is elongated in the same direction as the longitudinal row of which it forms a part. It will also be noticed that the radial walls tend (at least in a large number of cases) to cut the walls on which they abut at right angles §. If every cell grew with equal rapidity and vigour and the divisions followed quite

* Nuclei are now known to occur in many freshwater Algæ hitherto considered to be without them. See Schmitz, Bot. Zeit. 1881, p. 82.

† Strasburger, 'Zellbildung und Zelltheilung.' See also a paper by J. T. Cunningham in Quart. Journ. Micr. Sci., January 1882.

‡ *Cf.* also Schwendener, 'Das Mikroskop,' 'Die Gesetze der Zellentheilung.'

§ *Cf.* Sachs, "Anordnung d. Zellen &c."; also Pringsheim, in Jahrb. für wiss. Bot. ii. 1: and Rosanoff, "Recherches sur les Mélobesiées," in Mém. de la Soc. Imp. de Cherbourg, 1866, tom. xii.

regularly, there is no reason why the above disk-like structure and form should be altered. As a matter of fact, however, a perfectly regular circle is not maintained for long: at certain points in their progress on the surface of the leaf, the marginal cells meet with minute obstructions to their spread, while individual cells of the thallus produce hairs &c. as described, and others cease to divide in the usual manner. At any such point of arrested or modified growth * an indentation of the margin is apt to be produced as the surrounding series of cells grow forth into a lobe or branch. In some cases these lobes and sulci are developed with such regularity that a more or less stellate form is assumed by the older thallus (Pl. XVIII. fig. 2); at other times, and especially where the attacks of a fungus &c. or some diseased conditions intervene, very irregular, one-sided, and apparently lawless growths are set up.

Nevertheless even a single lobe of an advanced thallus suffices to illustrate the manner of growth and sequence of cell-divisions described. In fig. 5 *c*, for instance, and in Pl. XX. figs. 39 & 40, this is fully attested; and even in cases where the numerous checks encountered in the horizontal extension of an advanced thallus have caused so many aberrations that all regularity appears at first sight to have been destroyed, investigation of the separate portions confirms the truth of the above remarks.

When the disk has thus increased in size, and produced a thallus of which certain cells give off rhizoids, others, marginal and subäerial, barren and fertile hairs, as described, it usually happens that certain older cells become transformed into what are presumably some kind of reproductive organs, as follows:—The cell becomes swollen, with increase in volume of its fat-and-starch-containing protoplasm, into an ovoid sac, the walls of which bulge on all sides, pushing apart those in its immediate neighbourhood as they do so (figs. 39 & 40 &c.). The dense orange-red protoplasmic contents then become slowly rearranged into finely granular masses, and break up into a number of spheroids tightly packed in the swollen sac, and each of which finally separates as a distinct naked mass of protoplasm. At this stage the contents give a deep blue reaction with iodine; and alcohol causes the spherical bodies to contract and appear like small shot tightly compressed in a case (figs. 19 *a* & 42). At a later date these escape as zoospore-like motile bodies, each moving by means of two long flagella placed at the anterior end (Pl. XX. & XXI. figs. 43, 45–47).

If Pl. XIX. fig. 16 and Pl. XX. fig. 39 be compared, it will be seen that these sacs containing zoospores arise at definite points in the thallus, and that each is the terminal cell of a given radial row of thallus-cells. In fig. 40 *a* have been depicted two of these transformed cells, with the adjacent vegetative cells in outline; and at *b* is given a semi-diagrammatic figure, which would be produced if the adjacent radial cell-rows were separated, as sometimes occurs in fact (fig. 6 *d*). Two events come out distinctly in this typical figure:—first, that the ovoid sac is the terminal cell of a series, as said; and, secondly, that the regularity of the typically dichotomous mode of branching becomes disturbed by this suppression of growth of one arm of the cell-series. In fig. 12 the character of the ovoid sac and its relation to the rest of the thallus is made out with equal

* The marginal short hairs are frequently found in tufts; and these conclude the extension of several contiguous cells.

clearness in a fortunate vertical section passing radially through an arm of the latter. Under certain conditions very many of the cells become thus modified.

After the protoplasmic contents (in which are contained much coloured fatty and starchy matter) have become transformed into the young zoospores *, some time frequently elapses before further changes occur. If a thallus in the condition of fig. 16 be allowed to remain tolerably dry for a day or two, and be then moistened with water under the microscope, the sacs may be observed to burst one after another in somewhat rapid succession, each emitting numerous actively moving zoospores from a perforation in the apex. This perforation is at first sight somewhat complex: the wall of the sac itself presents a slight papilla with a round opening or pore; but above this is frequently seen an irregular, usually long slit, through a thin homogeneous membrane on the exterior; this membrane is a cuticular one, apparently proper to the thallus, and seen in vertical sections (figs. 8 & 12) from an early date. It is not an uncommon event to see several of the zoospores remain behind, and move about actively for some time in the otherwise empty sac (fig. 43).

The zoospores emitted by this sac † are remarkable bodies in several respects: each passes out as a delicate fusiform body, measuring about $\frac{1}{6000}$ to $\frac{1}{5000}$ in. long, with granular contents, and a distinct orange tint, due apparently to small granules of the same nature as the oily globules &c. in the thallus-cells. Its motion is at first very rapid, with a constant tendency to jerks; and one cilium is trailed laterally, while the other moves actively in front (Pl. XXI. fig. 47). In a minute or so the jerking motion is replaced by an even gliding, the zoospore swimming round and round in circles, both cilia being now usually active. This movement soon becomes slower, and as it does so the fusiform shape becomes exchanged for a spherical one, until, usually within three minutes or so, the zoospore comes to rest as a perfect sphere, with two slowly waving flagella at one pole. Within the next two minutes or so the feebly waving ends of the flagella come to rest, coiling themselves irregularly, or forming two circular loops (fig. 47), with the ends approximated or united. Many of the spheres now absorb water, swell up like hollow vesicles, and burst irregularly, scattering the small oval granules, which dance about with active Brownian motion. The above sequence of processes is not described for one case only; I have observed it many times. In some cases there have been more than a hundred of the sacs bursting at once; and each emitting many zoospores, certainly more than thirty or forty.

One of the sacs, measured just before bursting, was about $\frac{1}{1200}$ in. long by $\frac{1}{1300}$ broad; and the spherical zoospores, just come to rest, measure, on an average, about $\frac{1}{6000}$ to $\frac{1}{5000}$ in. in diameter. The very small pale oval granules found in the zoospore, and set free when it bursts, average, as near as I can measure, about $\frac{1}{40000}$ in. long. These bodies are often seen moving in the zoospore, and tend to become arranged at the periphery

* This term is here used provisionally; no proof exists of the exact nature of these bodies, as in the case of the zoospore derived from the "fertile hairs."

† I have purposely avoided suggesting a name for the sac and its contents, since the functions of the zoospores are not yet clear.

when it comes to rest (fig. 47) *. I could not detect a distinct blue coloration with iodine, though in some cases they appear to be tinged with a faint rosy violet or mauve hue.

On several occasions, after lying for from three to twenty hours in water, most of the zoospores appeared to have burst; in other cases they lost colour and shrivelled up. No attempts to cultivate them have succeeded; and I have never observed them conjugate with one another or with any other body. Whether they are of the nature of antherozoids or asexual reproductive zoospores must be considered undetermined. That they are zoospores developed by a fertilized oosphere, the ovoid sac being a female reproductive organ, seems to me in the highest degree improbable, since I cannot think the fertilization-process of so relatively large a body can have escaped observation †.

If we now give attention to the "fertile hairs," the second of the two kinds of subaerial trichomes shortly referred to above (p. 91), the following facts have been ascertained concerning their structure and functions.

I have already stated that these hairs arise from single cells of the thallus. Each commences as a simple papillar bulging of the upper wall, which grows forth perpendicular to the plane of the thallus and leaf, extending apparently by apical growth. Careful examination shows that each cell producing one of these structures is definitely situated with regard to other cell-series, similarly to those which become metamorphosed into the zoospore-producing sacs just described. Each "fertile hair" springs, in fact, as before, from the end cell of a series (*cf.* Pl. XIX. fig. 15), and therefore concludes the further development of that series as a constituent part of the thallus-plate.

When completely formed, the typical "fertile hair" (fig. 21) consists of a swollen thick-walled basal portion, arising from the end cell of a series, as said; and from this proceeds a stiff stalk composed of four or five long cylindrical cells, standing freely into the air. The uppermost of these supports a swollen subglobular cell (figs. 24 &c.), from the sides of which are protruded about ten short curved pedicels, each of which supports an ovoid smooth sporangium-like body, filled with dense finely granular protoplasm, which later becomes broken up into zoospores.

All these parts, the basal cell, the several cells comprising the stalk or "hair," the upper swollen subglobular cell, and the pedicels, are firmly and distinctly separated by transverse septa one from the other. All contain protoplasm mixed with granules, orange-red oily globules, and abundance of starchy matter, such as were met with in the thallus-cells. The peculiar thickening of the walls of the basal cell (fig. 25) may perhaps be correlated with the necessity for firmness to support the relatively heavy and bulky parts above. The thick cell-wall is partially cuticularized, and evidently stratified or divided into "shells." In some cases, at least, the outermost of these "shells" becomes more or less separated as a sort of sheath, reminding one to a certain extent of what occurs in the trichomes of *Coleochæte* ‡. The walls of the succeeding cells of the hair offer no special peculiarities, excepting that they often possess small irregularities on

* I have observed a similar phenomenon with the colourless zoospores of *Pythium gracile* as they come to rest before germination.

† Reference is made below to some statements bearing on this subject.

‡ V. Sachs, Text-book, p. 233, 3rd ed.; and Luerssen, Med. Pharm. Botanik, i. p. 110. Pringsheim, Jahrb. f. wiss. Bot. vol. ii.

the inner side (fig. 26), projecting slightly into the cavity of the cell. In some cases a definite faint stratification appears in the firm walls of these cells also.

The apical cell of this series, as also those of the pedicels which spring from it and the ovoid bodies supported by them, all possess thinner and smooth cellulose walls. No definite nucleus has been discovered in any of these structures.

In fig. 24 are drawn the various stages of development of the apical portion of a "fertile hair," after it has elongated, from a mere papillose projection of the thallus-cell, to nearly its full extent (figs. 15–21). The terminal cell of the primitively simple series (fig. 20) becomes swollen into a pyriform shape (fig. 24 *a–c*), from the upper portion of which are produced pairs of sacculations, which grow obliquely upward and outward, and become separated from the central body by simple septa (*d–f*). Meanwhile the protoplasm containing oil and starch, which had previously become aggregated in large quantities in the apical cell, passing into these diverticula as they are formed, becomes finely granular, and collects at the free end of each pedicel, causing it in turn to swell up into a pear-shaped dilatation (fig. 24 *f*). As this increases in volume, and more and more fine-grained orange-coloured protoplasm, sap, &c. are poured in, it bulges outwards as an egg-shaped body, which may be termed a zoosporangium, and a septum commences to form, separating its cavity from that of the pedicel (fig. 24 *e*, &c.). This occurs in such a manner that the ovoid body becomes situated obliquely on the pedicel (*cf.* Pl. XX. figs. 28–31), the latter joining it at its lower third.

From eight to twelve of these radiating pedicels &c. are commonly formed in succession from one terminal or head cell of the "hair;" and it follows from the mode of development that successive pairs are younger than those preceding. It may, however, happen that, after producing a dozen or so of these bodies, the vigorous "head-cell" grows forward and, after producing a short continuation of the main axis of the "hair," again commences to repeat the above-described phenomena: in fig. 22 the two tufts have arisen by this means. In other cases (especially, it would seem, after injury to the upper portion of the fertile hair) a diverticulum may arise from a lower cell, and form a lateral branch, which acts as if it were the main axis (fig. 23, *a*), and produces a terminal tuft of pedicellate sporangia as before. Or the continuation of the vigorous axis may precede the formation of pedicels by the end cell (fig. 23, *b*). Finally, I have several times observed a branch springing from halfway down the main axis, and producing a normal tuft of pedicels and ovoid zoosporangia, the main axis at the same time bearing a completely developed tuft as above described: this case is a rarer one, however. In the typical example above described the end cell produces the pedicels and zoosporangia in pairs, more or less nearly at equal intervals; abnormal cases occur, however, where one pedicel and its ovoid cell are formed long before others appear (figs. 23 *c*, 20, 21).

The pedicels developed as lateral diverticula from the central head cell, and which produce the large egg-shaped zoosporangia as described, soon become curved in a peculiar manner as the bodies which they support increase in size and, presumably, in weight. Each becomes partially doubled on itself from below, as if the weight of the zoosporangium had borne down the end: in consequence of this (figs. 29–32), the cell-wall of the lower side becomes tucked in as a double fold, partially shutting off the outer third of the cavity of the pedicel from the inner two thirds. It must be borne in mind that some protoplasm, as well as starch and orange-red drops remain in all these parts, although by far the larger portion has now been passed on to the ovoid zoosporangium at the end of each pedicel. It so happens that a curious mechanical action is brought about by the above disposition of the parts. When the uninjured fertile hair and tuft are moist and turgid, the pedicels all radiate stiffly from the central cell, and support the ovoid zoosporangia obliquely attached to their ends in such a manner that one end of the egg, so to speak, faces directly downwards, towards the plane of the thallus beneath; when, on the contrary, the parts are drier and consequently less turgid, the pedicels contract and fold, each on itself, and draw the zoosporangia closely around the central or head cell, into a sort of compact nest. The septum which separates the pedicel from the zoosporangium is not a simple complete wall of cellulose across the whole diameter, but remains open in the centre for some time. The junction of the two bodies, just before the latter falls, is of a peculiar nature; and on the detached ovoid body are seen two concentric circles (fig. 33), corresponding, apparently, to two areas of attachment, as follows.

When the septum first forms between the pedicel and the ovoid body, it only constricts the originally wide aperture by about one half, a circular hole still remaining in the centre and affording communication between the contents of both pedicel and zoosporangium. When the zoosporangium is ripe this little hole becomes covered by a lamella of cellulose, which is so far a new structure that it appears patched, as it were, on to the older partial septum. The consequence is, that just before maturity the two structures are united by two concentric areas of attachment—an outer old one, and an inner newer one*. In this way only can I explain the constant appearances figured at Pl. XX. figs. 29, 32 & 33; compare figs. 30 & 31.

It has been already stated that finely granular protoplasm and food-materials, in large quantities, become passed on into the ovoid young zoosporangia through the pedicels &c. After becoming clearer and still more finely divided, the now bright orange-coloured contents slowly accumulate at many centres, and form numerous densely packed spherical bodies (figs. 29–31).

Meanwhile at that pole of the zoosporangium which faces downwards a papilla arises, apparently from the softening and thinning of the cellulose wall; this absorbs water, and soon comes to look like a pale drop projecting from the surface. I have no conclusive proof that any of the protoplasmic contents participate in the formation of this diffluent droplet; nevertheless in some cases (fig. 31 *a*) the contents appear to be pushing the papilla outwards, while some hours afterwards (in water) they may contract away from it (*b* & *c*), even after the hyaline papilla has opened. Some time after this the small spheres, having become isolated from one another, commence to make their way out by a circular hole corresponding to the point where the drop-like swelling described above was formed, each becoming a distinct motile zoospore (figs. 35 & 36).

Each zoospore, when fully formed, is so like the spherical later state of the similar bodies emitted from the cells embedded in the thallus, that it becomes very difficult to

* An equally curious and more complex phenomenon of a similar kind occurs in *Ballia callitricha*, according to Archer (Trans. Linn. Soc. 2nd ser. Bot. i. p. 212).

distinguish them by any features of size, shape, or colour. The chief differences I have been able to discover are, that the former (zoospores) slip out slowly from the orifice of the ovoid zoosporangium, and do not assume the fusiform state with jerky motion of the latter, but glide slowly about with the two long cilia widely divergent from the subglobular body of the zoospore. The act of emergence has been witnessed several times (figs. 35 & 36).

The globular zoospores often remain just outside the empty case, as if embedded in a gelatinous matrix, their cilia feebly moving for some time (Pl. XX. fig. 38). So far as I could discover, after much search and observation of numerous cases, no conjugation ever occurs. The contents of the zoospore resemble those of the similar bodies first described—finely granular protoplasm, with small orange-coloured oily particles, and about twenty or more pale ovoid granules of unknown though apparently amyloid nature. In water many of the zoospores swell up in a vesicular manner and burst, the granules dancing in Brownian motion. It not unfrequently happens that the free zoospores become attached to the sides of the thallus-hairs, and their further development can be watched without much trouble; after some days each becomes pale apple-green, the amylaceous and other particles apparently becoming absorbed by the cloudy protoplasm (fig. 37). In most cases a delicate but distinct limiting membrane is now formed, and a pale cloudy nucleus-like body can sometimes be detected in the centre of the mass. In this stage the zoospores are often to be seen on the epidermis of the leaf of *Michelia*; and by artificial sowings I have obtained them on *Coffea* and *Anona*. Their germination has already been described (p. 92).

In the rainy season, when the fertile hairs are especially abundant, the above-described zoospores become scattered widely over the leaves; and within a few weeks afterwards one finds the young disks, described above (p. 92), appearing in very large numbers. From the results of cultivation, and from the above facts, it appears fair to infer that this zoospore is always the originator of those disks; nevertheless I am not in a position to affirm more than that the cultivated zoospores come to rest, turn green, and commence to divide as described, whereas those obtained from the thallus-cells do not.

Nothing that can be construed as a sexual process has been observed by me, either prior to or during the evolution of the "fertile hair" or afterwards; I therefore feel obliged to conclude that we have in these zoospores the asexual propagating bodies of the Alga. Nevertheless it seems highly desirable that more extensive cultivation than I have been able to make should be carefully undertaken, to determine finally whether the zoospores from the thallus are really incapable of development, and, if not, whether they have any relation to the origin of the "fertile hair" or to the zoospores produced from it. This seems in the last degree important; for it is impossible to believe that the (so far as my experiments go) non-germinating zoospores have no function, on the one hand; and, on the other, it does not appear probable that both forms of zoospore are asexual reproductive bodies, supposing further investigators succeed in bringing about their germination.

It has already been said that I am not able to regard the latter as zoospores produced from a fertilized oosphere. If they are finally shown to be incapable of germination, they must probably be looked upon as of the nature of *antherozoids*, remarkable as this may appear. But if this be so, where is the female reproductive organ?

Not to carry speculation to absurd limits, it is conceivable that this has not yet been discovered; or, since negative results are of little value, the very complex "fertile hair" may prove to be in reality the female organ, and a process of fecundation is yet to be looked for prior to or after its extension. I have entered thus into the realm of suppositions, chiefly to show in what direction some highly interesting though very difficult investigations may be accomplished by those fortunate enough to be working on the spot *.

The Fungus, and Formation of the "Lichen."

On the upper surface of the leaves of *Michelia fuscata*, especially during the rainy season, there may almost invariably be observed copious networks of mycelial filaments, branching and anastomosing in all directions; similarly also on the leaves of *Thea*, *Anona*, *Citrus*, and the other plants enumerated at page 88, as well as on many other plants examined. Putting aside certain Fungus-forms the life-history of which is more or less known, and a few others occurring locally, as well as isolated spores not investigated, there is one form of mycelium so abundant (especially on *Michelia*), and so universally associated with the presence of the Lichen to be described, that one would be justified in pausing to consider it for this reason alone. The hyphæ of this mycelium present all the well-known characters of an ordinary Pyrenomycete. They are segmented into joints of nearly equal length by firm cross septa, and are copiously branched and anastomosed, and preserve a pretty constant diameter as they course over the surface of the leaf. The cell-walls are firm, and, when fully developed, brown or sepia-coloured. In Pl. XXI. fig. 61 is a portion of such mycelium as commonly observed. No haustoria have been found in connexion with the hyphæ; and in no case, so far as my knowledge goes, do the filaments enter the leaf of the plant, either through the stomata or otherwise. Two important facts have been made out in connexion with this mycelium. It springs from an oval, uniseptate spore, as figured in fig. 67; and it is apt to produce clusters of *conidium*-like bodies, such as are represented in fig. 56. These peculiarly dense radiating groups of spores are very common and very characteristic; and by their means (apart from the definite characters of the hyphæ themselves) the mycelium in question can be readily recognized at any time.

Occurring, as this mycelium does, so generally on the leaves of *Michelia*, &c., on which the above-described Alga is flourishing, there can be no surprise that the hyphæ occasionally, or even frequently, come across the thallus of the latter, and sometimes spread over its surface to a greater or less extent.

This occurs, in fact, very commonly indeed; and it is somewhat rare to find an Algal thallus in the wet season without more or less of the encroaching Fungus on or near it. Such has occurred in the example figured in Pl. XXI. fig. 56 and also in Pl. XX. fig. 27, *a* & *b*; the latter case is also extremely common; the Fungus-hyphæ, invading the Algal disk, and creeping up the hairs, produce their dense clusters of *conidia* around the latter, as represented. These phenomena are, I repeat, very common, and can be readily

* The above account should be compared with Mr. Cunningham's paper referred to in detail below, p. 108.

distinguished from the more casual occurrence of foreign Algæ, Fungi, &c. so usual on all such patches on leaves in the tropics, and especially on such Algæ as these, the hairs of which act readily as traps to catch any wind-blown or washed spores &c.

But the more or less accidental invasion of so widely spread a network would have excited little remark had it not been noted that definite changes in the organization of the Algal thallus accompany and follow from the invasion, and that, in proportion as the Fungus invests the Alga, the cells of the latter are affected the more. Nor is this all; the Fungus in its turn flourishes more luxuriantly as its invasion and, as will be shown, depredations on the thallus proceed.

The earlier inroads of the mycelium consist simply in the wandering of the hyphæ along and across the margins of the thallus, in ordinary cases; but later the filaments branch, anastomose, and rapidly spread over the surface, at length forming a superficial investment, often of some complexity. In numerous if not in all cases the Fungal threads follow the lines of cell-division more especially, and may be readily recognized by their brown tint as so doing (Pl. XXI. figs. 59 & 60). Having produced a tolerably complete investing web, so to speak, the mycelium soon afterwards commences to produce the first of its two kinds of fruit-body (figs. 60 & 64 &c.), a structure consisting of a capsule of matted hyphæ, in the interior of which arise simple, naked stylospores—a *pycnidium* in fact. The second, higher form of fruit-body, a *perithecium* containing asci, does not rise till later, as will be described shortly.

Now the point of importance to this inquiry is, that these two compound fruit-bodies, the *pycnids* and *perithecia*, only arise from the mycelium after it has successfully invaded the Alga-thallus; in no case, after repeated and long-continued search, have I found the fruit-bodies on the mycelium as it overruns the leaf. *Conidia* and hyphæ occur in plenty, both on leaf and thallus, but no *pycnids* or *perithecia*, until some progress has been made on and in the Algal thallus.

The investing mycelium, as said, frequently forms masses of *conidia*; and when all three forms of reproductive organs occur, they appear in this order—*conidia*, then *pycnids* (often crowded in dense clusters, see fig. 62), and finally the *perithecia*, which seem to be produced only after great vigour has been attained by the Fungus feeding on the Alga.

If a thallus of the type described earlier (p. 88) as grey, or greenish grey, be examined *en face*, it becomes evident that it differs from the first (orange-red or green) type chiefly in that the investing mycelium of the Fungus now under consideration has commenced to attack it; this is shown in fig. 62, where the mycelium has already made considerable advances, causing the orange-red or green cell-contents to become merged in a cloudy matrix. In this case, also, there are several groups of *pycnidia* formed. In figs. 57 & 58, which represent portions more highly magnified, the same events come out more distinctly, and again in figs. 59 & 60.

When this stage is reached it becomes evident that the cells of the thallus are affected in two ways: first, their mode and rapidity of division is interfered with; and, secondly, their cell-contents are more or less injured or changed. It frequently happens that, as in fig. 58, the cells attain a much smaller volume before dividing, and the rapidly following division-walls remain parallel to the circumference, until the power of growth seems to become arrested as the mycelial filaments extend over the cells; in such cases, also, the cell-walls become cuticularized, and a tissue is produced in many respects resembling true cork. In other cases, or at other points of the invested thallus, when the Fungus is very luxuriant, the cell-contents diminish in quantity and become broken down into irregular masses of orange-red oily matter; or they disappear altogether and the cell-cavity becomes filled with air, or air-containing masses of very fine filaments. These changes appear to result from the breaking-up of the larger filaments, which traverse the junctions of the cell (figs. 57 & 60) and make their way into the mass of rhizoids below (*cf.* also figs 65 & 66).

This more extensive invasion of the thallus (the protrusion of hyphæ between the cells and into the looser spaces among the rhizoids) is also brought about by branches of the mycelium which spread from the edges of the investing mass. In figs. 4 & 59 are shown well-marked and typical cases of this. The now richly developed superficial mycelium, which has spread over the whole area, sending branches down between the cells and forming the earlier *pycnidia*, on reaching the edges of the thallus, forms tufts of vigorous hyphæ, some of which radiate off on the surface of the leaf, and continue the superficial mycelium, while others make their way under the thallus, and proceed to ramify between the cells.

It thus happens that vertical sections of the thallus in this grey condition present the appearance depicted in figs. 64 & 65, where are seen the remains of the invested Alga, forming a sort of dome to a loose mass of air-containing Fungus-hyphæ, resting on the surface of the leaf, and having formed (in fig. 65) a *pycnidium* (which is partly cut away); in this example the Algal cells, forming a sort of "gonidial layer" on the upper surface, have orange-red contents; but cases occur where these are green, as also those of the rhizoid cells which are to be found among the hyphæ. Such would be the case, for instance, if the thallus of fig. 62 had been cut across the structure exactly as in fig. 65, but the red colour replaced by green.

At a stage later than this, when the Lichen may be considered fully formed, the mass of air-containing tissue * has much increased, and the contents of the Algal cells often become nearly all destroyed; true *perithecia* are then formed, in which asci &c. appear in due course. If the above description has been followed, it now becomes easy to understand how the advent of the investing mycelium may affect the colour, consistency, and form of the Algal organism chiefly concerned, and types of which are figured and described at the commencement of this paper.

It is conceivable that the parasitic mycelium (as it must be considered) may attack the host Alga at any stage, and that the lease of life enjoyed by the compound body, or "lichen," may depend on this, among other circumstances, *e. g.* the relative vigour and amount of the host, or parasite, or both. As a matter of observation, the Fungal hyphæ may commence to invest the Alga at any period, in some cases while still but a zoospore come to rest (fig. 54), or when only a very few cells represent the thallus (fig. 55); and in these cases there can be no doubt of its injurious influence. The weak, struggling cells, possibly stimulated at first, soon succumb, after making a few feeble and, it may be, irregular divisions (fig. 55). A very common case is that shown in fig. 56; and

* This also often effervesces in acetic acid, and contains $CaCO_3$ in minute granules.

here, too, the Algal disk, though bright green for a time (as if the presence of the Fungus implied the absorption of fatty matters &c., and impelled the green chlorophyll to increased labour), soon becomes a mere mass of empty cells. In such cases the Fungus appears unable to develope *pycnidia* or *perithecia**, though it commonly produces dense mases of *conidia*, each of which may extend it; indeed the production of such dense clusters seems to ensure a vigorous and rapid spread of radiating mycelium, extending on all sides and soon reaching other disks.

Where the Alga has arrived at a more advanced stage, however, it lives with the Fungus investing its cells, as we have seen, for some time; the amount of work it can do for itself during the presence of the mycelium (judging, of course, by the condition and growth of the cells) appears to depend simply on the degree of subjection into which the latter has forced it. If the very young Alga is at once and completely invested by the mycelium in abundance, no fertile hairs or zoospores of any sort appear to be formed, and very few rhizoids or barren hairs; if, however, a large thallus is invaded from one edge, the slowly advancing Fungus does little more than follow the thallus for some time, and it is certain that the Alga may retain vigour in its cells up to the formation of the complete Lichen. But it will be easy to understand that in such cases as the last, growth being modified at the points of severe investment, the circular or regular outline of the thallus may become affected. It is chiefly by these means, in fact, that the stellate and irregularly branched forms are produced, the portions not yet encroached upon growing out beyond the points of attack.

In other cases the Alga goes through its whole period of development without becoming captive to the mycelium, or the latter only invests it to such a small extent that the extension of vegetative and reproductive normal growths is not perceptibly interfered with. It may be objected that the above cases simply prove the presence of an Alga and a destructive parasite, and do not support the doctrine of "commensalism" applied to the nature of Lichens. It must be borne in mind, however, that although the completely invested Alga at length ceases to exercise its functions as an independent organism, there can be no doubt that many of its cells are living up to the latest period in the life of the Fungus (*i. e.* when the *perithecia* appear); and it does not seem logical to draw any sharp line at this period.

THE "LICHEN."

I have purposely reserved the details of structure of the completely invested thallus, and its two forms† of fruit-body, for description under this head, although it is clear that no line can be drawn showing exactly where this stage differs from the later ones already referred to.

If thin vertical sections through the complete thallus (fig. 3) and black dots of the Lichen be carefully examined, one obtains preparations such as are represented in figs. 64, 65, and 66, the two former passing through the smaller black dots or *pycnidia*, the latter through the large, true "fruit-body," or *perithecium*. As regards the smaller body, the

* *Perithecia* were never found until a vigorous mycelium had been formed on and in the thallus.

† In one doubtful example only have I seen a possible formation of *spermatia* in addition.

following facts are easily ascertained, since the *pycnidia* are commonly produced in large numbers by the Lichen.

The small black case, or hollow receptacle, arises directly from the brown hyphæ of the investing mycelium, soon after the latter has commenced to invade the underparts of the Algal thallus (Pl. XVIII. fig. 4, Pl. XXI. figs. 60 & 62), and seems to be produced simply by the weaving of these hyphæ into a feltwork which gradually acquires a subglobular form (figs. 60–63), and the outer walls of which become dark-coloured and hardened as is common with such hyphæ (fig. 64). Within this outer blackened shell is produced a more delicate lining of colourless filaments, closely matted together; from these are produced numerous short, slender *basidia*, directed in a convergent manner towards the centre of the hollow case; and from the ends of these *basidia* are abstricted minute colourless *basidiospores*, or *stylospores* (figs. 64, 65), each of oblong shape, and with one median cross septum. When quite fresh, and examined in water, the very delicate septum is not easily recognized; but four or five relatively large oily globules appear in the hyaline protoplasm composing the ground-substance of the spore. In alcohol or iodine, however, the globules disappear, and the septum becomes evident; and an exospore can be distinguished (fig. 64) from the very delicate endospore, in many cases becoming wrinkled and contracted away from it like a pellicle.

As the above-described *stylospores* increase in number and fill up the enlarging cavity of the *pycnidium*, a small, beautifully rounded aperture appears in the apex of the latter, through which the *stylospores* become extruded in masses, after the absorption of water (fig. 60), and are eventually scattered on the surface of the thallus and leaf.

The tissues between the numerous *pycnidia* (figs. 62 &c.) now consist of densely felted colourless and brown hyphæ (fig. 65), in the interstices of which much air becomes entangled, and, in some cases at least, minute crystalline masses which effervesce on addition of acetic acid. Under these circumstances it becomes no easy matter to examine this dense feltwork, unless very thin sections be treated with acids and alcohol, stained, and mounted in glycerine. If picro-carmine be used the prepared colourless feltwork becomes dyed pink, the cuticle of the Lichen and leaf yellow. Close beneath the cuticle of the Lichen are to be recognized the cells of the Alga, still containing more or less orange-red or green colouring-matter; and in some cases the rhizoid-cells with green contents may be observed among the meshes of the densely interwoven hyphæ (figs. 69 & 70). In no case, however, could I find either hyphæ or "gonidial cells" (as the rhizoids &c. may be considered) penetrating into the leaf.

After the colourless air-containing feltwork has become coextensive with the Algal thallus, filling up all the spaces between the cells, *pycnidia*, &c., and shining through the cuticle and more or less exhausted gonidial layers of the Lichen with an opaque white lustre, imparting the peculiar porcellaneous appearance so characteristic of the mature thallus (Pl. XVIII. fig. 3), the complete fruit-bodies or *perithecia* are produced, always in smaller numbers than the *pycnidia*.

Each *perithecium* (fig. 66) consists, as before, of an outer shell of coarser hyphæ, lined with a *hymenium* of densely matted, colourless, very delicate filaments, from which spring the *asci* and *paraphyses* in closely packed series, converging towards the upper part of the cavity of the *perithecium*; when mature, the spores, and sometimes *paraphyses*, are seen escaping through a round aperture at the apex.

The *paraphyses*, which are produced in immense numbers between the *asci* (fig. 68, *a* & *b*), are extremely slender straight filaments, with one or two hardy discernible septa, and a few granules scattered in the interior of their cells (fig. 68, *c*).

The *ascus* is a delicate, transparent, clavate sac, containing granular protoplasm, nearly the whole of which becomes converted into eight oblong spores, each at first resembling a *stylospore*, but eventually becoming relatively shorter and stouter.

When ripe the *ascus* (fig. 68, *d*) absorbs water, and bursts in the following manner:—The outer, extremely delicate and transparent wall, becomes divided along a line passing round the *ascus* a little below the apex; and a portion is thus separated like a cap from the rest. The gelatinous material lining this outer wall, and filling up the spaces between the spores (*epiplasma* of De Bary)—the remains of the original protoplasm which was not used up in forming the spores, and which absorbs the water and produces the pressure and tension resulting in rupture—then becomes extruded as a glairy mass, in which the spores are embedded. Curious axial rows of granules which appear during this process, as if connecting the spores end to end, are very characteristic, and seem to indicate the protoplasm remaining between the diffluent masses lining the *ascus*.

The ripe spore is a broadly oblong body, with a slight median constriction, corresponding to a faintly marked septum near the equatorial plane. About four large oily-looking globules occupy the interior; and it frequently happens that the septum cannot be distinguished until these are made to disappear by alcohol or ether.

On germination, each of the two cells of the spore produces a terminal hypha (fig. 67), which extends for some distance without branching, eventually becoming brown, however, and forming the typical mycelium already described.

Physiological and Pathological.

It is now time to consider the question, what obvious effects, if any, are produced by the presence of this organism on the leaves of the phanerogam? In this connexion, also, my researches apply more especially to the specimens on *Michelia*, though some points of importance are to be mentioned as regards *Citrus*.

It has been already stated that at a very early stage the naked or almost naked cell from which the Algal thallus originates (the zoospore which has come to rest, in fact) becomes closely applied to the cuticle of the leaf, and, indeed, practically becomes fused as it were into its substance. This phenomenon appears to be of an order similar to the boring process commonly found in the germination of the zoospores of certain parasitic Fungi, e.g. *Phytophthora* *, and can probably be imagined only as due to a power on the part of the zoospore to dissolve the material of the cell-walls &c. at that point. In the case of the present Cryptogam, however, this does not proceed so far as to produce a perforation into the leaf of *Michelia*; the zoospore merely fixes itself solidly into the cuticle, and proceeds to divide. However, from the character of the attachment of the rhizoids and larger disk of the thallus, it appears certain that these also have the power of partly fusing into the

* De Bary, "Développement des quelques Champignons parasites," Ann. d. Sc. Nat. sér. iv. Bot. tom. xx. &c.

cuticle, and this applies henceforth to the whole structure. In vertical sections through leaf and thallus (Pl. XVIII. fig. 8) this is plainly seen; the cuticle of the leaf is apparently continuous with the cuticle formed by the thickened outer walls of the thallus. In *Michelia* I have never observed this process to extend further.

In *Citrus*, however, an apparent extension of the above process takes place; and I have introduced a drawing to show this at fig. 13. The Algal thallus—quite typical in general characters, so far as I have observed—when considerably developed, is invariably found *under* the proper cuticle of the upper surface of the leaf. I have carefully attended to this point, and I am convinced of the generality of it; unfortunately no proof of how it occurs in the first instance has been obtained.

From an early stage the thallus appears as a boss of closely packed cells (chiefly ramifications &c. of the rhizoids) in several irregular layers, actively vegetating between the outer cuticularized walls and the inner ordinary walls of the epidermis-cells. The trichomes, again, pierce the cuticle immediately above their points of origin: this is true both for the fertile and barren hairs. In no instance have I observed the lower cells to penetrate into the leaf, though (as shown in the figure) the lower walls of the laterally ruptured epidermis-cells become brown and tend to disorganization.

In this case one may suppose that the zoospore, on coming to rest prior to germination, actually dissolves away the cuticle and outer layer of cell-walls, and that the luxuriant thallus results from the continued growth in the well-sheltered space beneath; but it seems impossible to avoid the further inference, that an actual destruction of the lateral wall of the epidermis-cells occurs here by *parasitic* influence on the part of the Alga. In some measure supporting this view is the fact that these subcuticular growths have less colouring-matter than the epiphyllous disks on *Michelia*. But another explanation of the process seems possible, and even probable.

The glands of *Citrus* are apt to burst and rupture the upper epidermis of the leaf. A zoospore might find in the damp, shady hollow thus produced no unsuitable spot for its germination and growth; and the lateral rupture of epidermal cells may be due to tension produced by the pressure of the growing Algal mass. It is not unworthy of remark that the points of exit of the two "hairs" (in fig. 13) correspond more or less with the shrivelled gland; and the same has been observed in other cases.

Another fact comes out clearly from such a section as is represented in fig. 13. Not only the cuticle extending over the thallus-mass, but all the leaf-cells immediately beneath are affected more or less injuriously, as shown by the sienna-brown colour with which they are tinted. This sienna coloration extends to the cell-walls and contents of several series of cells immediately beneath the body of the thallus, but is quite absent from those cells which are not covered by the Cryptogam. For the sake of simplicity only, I have not drawn the chlorophyll granules and other cell-contents; but it will be understood that the normal, healthy and chlorophyll-containing cells have been left colourless, whereas all that lenticular tract of cells coloured brown in fig. 13 is clearly and seriously altered. The cell-walls no longer give the reaction of cellulose, but resist the action of sulphuric acid, dyes, &c.; while the cell-contents are completely broken down, in a few cases to mere masses of resinous material. Nor is this all; the brown-coloured cell-walls are distinctly suberized, and it will be noticed that the cells of certain deeper layers immediately beneath the double "palissade" series are becoming *merismatic*; *i. e.* numerous division-walls appear in series parallel to the surface of the leaf, and rapidly cut off groups of outer cells from the mesophyll. A true *meristem* or *cambium* is formed; and, since (fig. 14) all the cells on the upper side become flat, tabular, or cuboid chambers filled with air and possessing suberized walls, the *meristem* must be considered a kind of *phellogen*, producing *phellem*, or cork, on its exposed side*. The boundaries of this *phellogen* area also correspond closely with the limits of the area covered by the thallus. Hence it appears necessary to infer not only that the presence of the thallus acts injuriously on the leaf-cells in its neighbourhood (putting aside for the moment the actually destroyed epidermis), but that the influence extends deeper, and the mesophyll proceeds to repair the damage by cutting out the injured layer with a lenticular layer of protective cork.

If we now turn to *Michelia*, however, where the Alga certainly does not pierce the cuticle, it becomes evident that the destruction of a mass of underlying cells, and their subsequent exclusion by cork, takes place there also. In figs. 7, 8, & 9 are seen cross septa in the palisade cells, immediately beneath even small specimens of the thallus (fig. 8), and exactly coextensive with it; in fig. 10 this feature has been carefully attended to.

Fig. 10 *b* represents an accurate drawing of the cell-walls as they occur in a normal area of the leaf, while *a* is an equally accurate figure of what is seen immediately beneath a young thallus (left out for simplicity).

The cuticle and epidermis, and one layer of completely suberized cells which have been cut off, are already sienna-brown; and a powerfully developed *phellogen* has arisen beneath by repeated division across the palisade cells, some of which are also distorted. The only difference between this case and that of *Citrus* is that in the latter the *phellogen* arises lower down in the mesophyll. Here, as before, the injured and reparative layers correspond accurately in area (fig. 8) with the surface covered by the thallus, and the suberized tissue outside the *phellogen* forms eventually a sort of slough.

It seems clear that the injury is not due to a direct parasitic action of the thallus (even in the extreme case of *Citrus*, I do not imagine the active development to depend so much on absorption of food from the living leaf as on the sheltered situation enjoyed by the ensconced thallus), since we have seen that the latter is completely external in *Michelia*. What, then, is the nature of the influence exerted by the epiphyte?

It is well known that processes of cell-division are very commonly executed especially in the dark †, and that in some cases the cells of lower plants do not divide to any important extent in daylight. Now, since the shading influence of the Alga-thallus must be considerable when well developed, it is at least possible that the cause rests partly or wholly in this.

We may probably picture the shaded cells using up all the available material in and around themselves, and then, being unable to manufacture more, gradually losing their

* Frank ('Die Krankheiten der Pflanzen,' p. 92) has also noted the healing of wounds in mesophyll by cork-formation.

† V. Sachs, Text-book, p. 674 &c.

activity; in some cases considerable hypertrophy occurs, as well as or preceding active division.

If the above view is correct, it might also be instructive to inquire how far the colour of the little light which does pass through the orange-red thallus may be concerned in the matter, if at all. No doubt the functions of the cells are more or less powerfully affected, at any rate, by the shading.

In the case of *Citrus* it may be that something must be placed to the absorptive power; how much, is very doubtful. The same hardly applies to the Alga on *Michelia*; it appears improbable that the rhizoids, even though embedded well into the cuticle, absorb even water directly from the leaf-cells in any quantity.

It seems unnecessary to discuss the possible modification of influence when the Alga has become invested by the lichen-forming mycelium, since a dense slough of corky tissues has generally become formed by that time. However, in some cases there is reason to suppose that, either from destructive shade or from absorption of moisture by the injured tissues, the affected patch gradually extends through the thickness of the leaf, and may even cause an irregular perforation to appear.

In connexion with this part of the subject, it may be not unprofitable to examine the changes which occur in the cells of the Alga-thallus before and during their investment by the Fungus. It has been already pointed out that the thallus of both young and old specimens of the Alga may be green or more or less orange in colour, according to circumstances, and that this results, immediately, from the presence in the cells of an apple-green colouring-matter diffused through the cell-protoplasm, together with isolated or aggregated yellow or orange-red oily drops which may become so plentiful as to mask the green tint. The orange-coloured drops also occur in the rhizoid-cells, but are usually far less abundant there.

I have tried to ascertain the conditions which decide whether the oily drops become formed in sufficient quantity to mask the green colour, or remain in abeyance. It appears the rule that in the rainy season, when the sun-light is frequently obscured by clouds for long periods and the average temperature is on the whole lower, the green colour predominates; and at such times one often observes the thallus-cells to contain fewer and smaller drops of yellow or orange matter (Pl. XVIII. fig. 6). On the other hand, in the very hot, dry season, the thallus-cells frequently present scarcely any green colouring-matter at all, but are occupied by large orange-coloured drops, peculiarly lustrous and oily-looking, and no doubt consisting of fusions of the otherwise isolated drops, and which give a very decided deep-blue reaction with iodine. At fig. 6 *b* are represented several cells in this condition; but it frequently happens that the oily drops are larger even than in this example, and may occupy nearly the whole of the cell-cavity. An intermediate stage, where the aggregated oily drops form large masses in the otherwise green-coloured matrix, is seen at fig. 5 *a* & *b*.

It seems impossible to avoid connecting the intensity of the sun-light, and the high degree of temperature, with the increase in number and size of the oily drops and the starchy matter mingled with them; and since both must be regarded as products of the action of the green-coloured protoplasm*, we must suppose that the latter body becomes in part destroyed when the intensity of light and temperature approach a maximum. This appears still more probable on examining fig. 6 *c*, where the cell-contents are seen to have undergone yet further (oxidation ?) changes.

In this case the leaf and thallus had been exposed to a blazing sun in the hot dry season for some time, and the oily drops had become reduced in quantity without any restitution of green colour; but certain waxy-looking, colourless, vacuolated globules in the cells seem to have replaced the partially destroyed cell-contents. Of the exact nature of these bodies I can give no information; but it seems almost certain that they were formed under the prolonged action of intense metabolism of the coloured protoplasm†.

MYCOIDEA PARASITICA, *Cunningham*.

In the 'Transactions' of the Linnean Society of London for January 1879 (2nd series, Bot. vol. i. p. 301) appeared a remarkable paper by Mr. D. D. Cunningham, bearing the above title, and which was brought to my notice after much of the work detailed in the preceding essay had been completed. From a careful and critical examination of Mr. Cunningham's able memoir, it seemed probable that the Cryptogam to which he gave the above name, and which he found in Calcutta on the leaves of *Camellia japonica* &c. "as a destructive blight," may be identical with the Alga found by me in Ceylon. If not, we are at least concerned with closely allied species, as I have convinced myself by actual examination of Mr. Cunningham's preparations‡ (unfortunately in a bad state of preservation) now in the British Museum.

The Cryptogam described by Mr. Cunningham was observed also on the leaves of *Rhododendron*, several ferns, crotons, and other plants, and on tea, a fact which, as the author points out, possibly "lowers the parasitism of the Alga." The firm nature of the epidermal covering in all the leaves affected is also noted.

Cunningham finds that the parts of the *Camellia*-leaf affected with the Alga become destroyed, the discoloured and injured tissues sloughing away, and sometimes leaving holes in the lamina; and he further attributes this destruction to the distinct and direct parasitism of the Algal thallus, which sends haustoria into the leaf-tissues. The general nature of the latter, and of its erect filaments, radiating cellular structure, &c. had been already recognized; and my observations confirm several important points. Some differences in detail, however, led me to continue my work, as well as to reexamine the contested point; and it may be well to take in sequence those observations and inferences with which my own are not in accord. It should be mentioned that Mr. Cunningham had also recognized generally the relations of the Alga to the formation of a "Lichen," though in his examples it appears probable that a different Fungus is concerned and a

* Unfortunately I have no exact observations to prove definitely that the green colour is due to chlorophyll; but it is an obvious inference from all the facts that it is such a substance.

† Certain facts, not yet completely investigated, tend to show that this is a common phenomenon, as is also the immediate passage of products of assimilation into oily matters.

‡ Through the kindness of Mr. G. Murray.

totally different Lichen is figured*. In systematically criticising those points in the paper referred to with which my observations do not agree, it should be borne in mind that I have had no opportunity of examining the Calcutta forms in their natural living conditions, and it is therefore not impossible that the Alga and Lichen described and examined by me may be specifically different from "*Mycoidea parasitica*."

Cunningham figures (pl. xlii. fig. 8) a vertical section through the *Camellia*-leaf and its attached Alga, and figures certain green cells of the latter as passing through the epidermis of the leaf into the region of palisade cells. These descending cells apparently correspond to the "rhizoids" of my Pl. XIX. figs. 12, 17, & 18, and which I have never seen breaking through the leaf-tissues†. There appears to be some slight confusion between Cunningham's fig. 8 (pl. xlii.) and the sentence on page 304 of his paper:—"The filaments of the disk are seen to lie between the epidermis and the subepidermal layer of cells." It appears probable that the condition of affairs here figured corresponds pretty closely with what I have observed in *Citrus* (fig. 13), and that the Algal thallus had become developed between the cuticle of the *Camellia*-leaf and the more or less broken-down epidermis cells; if not, the figure conveys the idea that the thallus is vegetating *on* and not *under* the epidermis, but that the cuticle of the leaf and that of the Alga have become coextensive. If the green prolongations are really protruded parasitically into the leaf, two difficulties suggest themselves: why are they confined to a central tuft? and why do they remain green? These difficulties are not explained by the context; and it appears more than possible that the discoloration of the affected area of the leaf is due, not to direct parasitic action, but to influences similar to those exerted by the Algal thallus on the leaf of *Michelia*. Nothing in the figure suggests the definite formation of a corky tissue; if this occurred, the brown colour and sloughing might be explained.

My observations confirm generally, and extend in detail, the description of the filaments and "asexual fructification"; but the observations on the so-called "sexual fructification" in the paper cited are in such startling contrast to my own, that serious doubts may be entertained either as to the identification of the two Cryptogams, or the accuracy of Cunningham's description.

Cunningham found that certain cells of the thallus (corresponding morphologically, apparently, with the zoospore-containing cells in my Pl. XX. figs. 39, 40, &c.) swell up, each forming "an obovate dilatation," with a thick cell-wall, the orange-red protoplasm of which becomes accumulated into an "oospheric mass," and the whole becomes an "*oogonium*."

The author goes on to say (p. 307):—"Due to the dense nature of the disk (thallus), to its subepidermal site, and to the fact that, when detached from the leaf, only retrograde changes, tending to a recurrence to pure vegetative growth, occur in the developing fruc-

* There is nothing remarkable in this: the same Alga often serves as host for several different Fungi; and I have evidence to the same end as Bornet, who refers the Lichens *Verrucaria*, *Roccella*, *Chiodecton* and several others to combinations of *Chroolepus* and a Fungus. *Vide* Ann. des Sc. Nat. 5[e] sér. tome xix. p. 315 *et seq.*

† Cunningham's figure is by no means decisive: the appearance might easily be caused by "dragging" of the rhizoids by the razor; and the beautiful bright-green colour of his "haustoria" is not suggestive of parasitism.

tification, I have been unable to follow out the further steps in the development of these cells (or oogonia, as they now are). In so far, however, as very numerous examinations of separate specimens are capable of throwing light on the matter, the following appears to be the order of events." The author then describes the origin of "numerous slender-branched filaments from the neighbouring cells of the disk. Some of these become dilated at the extremity; and the large terminal cell becomes applied and closely adherent to an oogonium (pl. xlii. fig. 12). These filaments appear, as a rule, to arise from the under surface of the disk; and those which are developed into pollinodia are usually attached to the oogonia towards their bases. The contents of the terminal adherent cell appear next to be emptied into the oogonium, and to blend with the oosphere. Owing to the reason previously mentioned, this process has never been actually observed to occur."

The "oogonium," containing an "oospore," is then stated to become loose, and to remain for some time among the débris of the thallus, and finally give rise to "zoospores," which produce, eventually, new Algal disks.

Two views are possible of the above series of events, assuming that *Mycoidea* and the Alga observed by me are generically the same. Either Cunningham discovered a female organ of reproduction which I have not seen, and which becomes fertilized and produces zoospores as described by him, or he confounded the organs already described. In offering the following criticism, I shall, for the sake of argument, assume that the Algæ are identical; otherwise the remarks, presented in no captious spirit, are of little value. It seems extremely unlikely that such an organism as this *Coleochæte*-like Alga would produce three sets of zoospore-like motile bodies agreeing in all essentials of size, colour, cilia, &c.; hence it is not probable that the *asexually produced* zoospores of my figs. 39 to 47 play the part of antherozoids towards an oogonium, which again produces zoospores of similar size, constitution, &c. My observations confirm those of Cunningham respecting the production of zoospores from the ovoid bodies supported on the heads of upright filaments (figs. 2, 4, 5, pl. xlii. Cunn., & my figs. 21 to 38); and I have seen the zoospores from the thallus-cells (my figs. 39 to 47) so frequently, in some instances scores of the cells (fig. 12) bursting one after another in the field of microscope, and in no case been able to detect any thing like a conjugating process, that I can no longer consider it doubtful.

At Pl. XIX. fig. 19 *a*, I have drawn one of these zoospore-containing cells of the thallus, seen from the under side, together with several of the rhizoid-like outgrowths of the same order as those of figs. 12 and 17 & 18; and it might be suggested that these are possibly of the nature of Cunningham's "*pollinodia*;" but it is obvious that the contents of the zoospore-producing cell have already commenced to form the zoospores at a period when the rhizoids are certainly not emptying anything into the cell; the attachment of the "rhizoids" cannot, therefore, be regarded as of a sexual character. Moreover in most cases I find no such production of rhizoids so close to the cell, and the latter produces its zoospores without any approach of such bodies.

It is sometimes very difficult to determine exactly the nature of the basal cell of the "fertile hair," when examining the surface of the thallus; from the thickness of its walls, dense orange-red contents at first, and other circumstances it might possibly be mistaken for a distinct organ. It would be important to determine whether any process prior to the upgrowth of the "fertile hair" can be regarded as sexual: my observations certainly allow no such view.

Another point, noticed by Cunningham, renders it almost certain that we both refer to the same cell in the terms "oogonium" and "zoospore-containing cell of the thallus" respectively: he notes (p. 309) that "the zoospores, when first emitted, are of an oval or pear-shaped form." "Eventually they cease to move, and become spherical;" *cf.* my statements, made quite independently and before I had seen the paper referred to, on p. 94 of the present memoir. He is of opinion, however, that these zoospores reproduce the plant directly; my observations fail to confirm this.

It must be admitted that much remains to be done in connexion with the reproduction of this Alga; and probably no more interesting subject presents itself to the investigators in tropical and subtropical countries than this.

It will be obvious that, if my criticism is of value, serious objection must be made to the definitions on p. 312 of Cunningham's paper until more definite knowledge is obtained respecting the alleged parasitism and sexual propagation of this Cryptogam and its allies. The epiphyllous Lichen referred to in the above paper is clearly not the one here described—a fact which may possibly be also quoted against the assumption that the Algæ are identical, though I cannot admit its validity.

Something more in detail may now be said as to the systematic position of the Alga and resulting Lichen above described; and since Cunningham's new genus "*Mycoidea*" cannot be accepted on its present basis, the following remarks will also apply generally to the organism he described in Calcutta.

Reference has already been made to the resemblances in external appearance and mode of growth of this Alga to what Pringsheim * has described for *Coleochæte*. The most striking divergences from that type offered by the new Alga are connected with the habitat, the "fertile hairs," the rhizoids, and the peculiar orange-red contents of the cells. These differences are important; and careful comparison with *Coleochæte* suggests that, after all, there is very little in common between the two beyond the mode of growth of the disk-like thallus and the production of zoospores from certain cells †.

Can we suggest any other possible ally? I think we can. The genus *Chroolepus* presents features which agree with what occurs here in several important points. In the orange-red oily cell-contents, in habitat, and in the production of similar zoospores in ovoid cells developed terminally and laterally from the cell series, we have remarkable points of agreement between the two forms ‡. The mode of growth of the disk in our Alga is in no way subversive of the value of these analogies, if we reflect that here, as in

* Jahrbuch für wissenchaftliche Botanik, ii. 1.

† I may here place on record the discovery of some very minute shield-like bodies attached to the threads of Confervæ and *Chætomorpha* found on the Ceylon coast. These disks resemble *Phyllactidium* (Kützing, Tab. Phycol.); but many of the minute cells contain bright rosy-red colouring matter. I know nothing of their development or reproductive organs.

‡ For the literature of *Chroolepus* conf. Rabenhorst, Flora Alg. Europ. p. 371 *et seq.*, and Kutzing, Tab. Phycol 91–97.

Coleochæte, forms occur where the cell-rows are not laterally united, but branched loosely as in the typical species of *Chroolepus*.

But the importance of these analogies comes out more strongly if we compare the organization of the "fertile hairs"—each of which, be it remembered, is a production of the end cell of a series of thallus-cells—with what Gobi found in *Chroolepus uncinatus**.

This species occurred, mixed with *C. umbrinus*, on the bark of trees around St. Petersburg, in the spring and summer of 1871, as minute aggregations of loose or compacted cell-masses. The vegetative cells were made to pass through just such changes of colour as I have described, and as Cunningham noticed, according to the state of moisture or dryness of the atmosphere; by keeping one half of a specimen wet in sunlight, it turned green, the dry half remaining orange-red. In the cells of the latter were red oily drops, which in the moist specimens decrease in quantity, and form mere red spots in a green matrix, or disappear. The reverse effects were obtained on altering the conditions; and similar phenomena were observed on rocks, bark, &c. in the open.

The cells which form zoospores are always orange-red ovoid dilatations situated on short curved pedicles developed from the sides or apices of the vegetative-cell series. If the figures on Gobi's plate are compared with Cunningham's fig. 2, or my figs. 21, 24, 31, &c., it will be seen that what I have termed a "fertile hair" might almost be replaced by a fertile thread of *Chroolepus uncinatus*. The chief differences are the fewer numbers of zoosporangia in the tuft, the less evident central cell, and thinner walls of the *Chroolepus*. The oblique insertion of the pedicels at the lower third of the ovoid zoosporangium and their mode of attachment by a double ring, the papilla at the base of the latter resulting from a change in the cell-wall, the deep orange-red colour, size, and what details are given of the development, simply recall what I have described.

Moreover these free sporangium-bearing threads pass down to cell-series which are spread flat on the substratum. If we supposed the irregular distribution of these "vegetative cells," to be replaced by a more orderly arrangement, due simply to simultaneous divisions in all the equivalent parts, a disk like that of *Coleochæte*, or the above-described Alga would result; from this disk would spring the sporangium-bearing filaments as "fertile hairs." I believe it is not going too far to carry these analogies one step forward, and imagine what would result if some of the zoosporangia never became raised above the surface, but remained in the thallus thus produced; if so, we could explain the zoosporangia of the thallus in the tropical Alga, and account for the extraordinary agreements in their position (as regards cell-series), size, &c., and formation of zoospores so like those from the "fertile hairs" in size, form, colour and number, &c. If some such agreement does not exist, I see no escape from the temporary conclusion that a loss of function occurs here, or, if the zoospores prove capable of germination, that a case of apogamy is established.

I believe that the foregoing comparison is a sound one, and that the tropical Alga (which still lacks a name) must be looked upon as a higher development of the *Chroolepus*

* "Algologische Studien über *Chroolepus*," in Bull. de l'Acad. Imp. des Sc. de St. Pétersbourg, tom. xvii. 1872, p. 123. I have to thank my friend Mr. W. T. Thiselton Dyer for calling my attention to this important memoir.

type, along similar lines to those followed, for instance, in comparing *Coleochæte divergens* and *C. scutata*, or in deducing any more compound type from a simple one.

This mode of viewing the question seems to throw light on some other points of interest. Bornet, in his remarkable researches on the Gonidia of Lichens *, has shown that the genus *Opegrapha* consists of a Fungus-invested Alga which he refers to two genera. The gonidial layer of *Opegrapha varia* is, in his opinion, a *Trentepohlia*, while that of *O. filicina* must be referred to *Phyllactidium*. He also shows that *Trentepohlia* enters into the constitution of several other Lichens (*Verrucaria*, *Roccella*, *Chiodecton*, "*Byssocaulon*," "*Cœnogonium*," &c.) †. Now the genus *Trentepohlia*, founded by Martius, is sunk in *Chroolepus*, Ag., although Bornet wished to preserve the old name. The genus founded by Kützing under the name of *Phyllactidium* is merged in *Coleochæte* by Pringsheim ‡.

From these considerations it is evident that, in the first place, such Algæ as I have described have already been recognized as the gonidia of Lichens, and, secondly, that a considerable amount of uncertainty exists as to the exact relationships of the genera.

Bornet, in his second note on the gonidia of Lichens §, describes old specimens of *Opegrapha varia*, in which were found filaments of the *Trentepohlia* (*Chroolepus*) bearing sporanges, from which zoospores escaped through projecting ostiola: many zoospores were also found in the water.

Millardet, in 1866, discovered an epiphyllous Alga on *Abies pectinata*, which he named *Phycopeltis epiphyton* ‖. I have seen one of the original specimens of this form, through the kindness of my friend Prof. de Bary ¶; and there is sufficient resemblance between it and the tropical Alga (especially the young states of the latter) to encourage the hope that we may have representatives in Europe which can be studied in the living state.

The Alga forms small discoid growths on the leaves of the damp lower branches. Its comparatively large cells are filled with orange-red oily matter; and certain of these become distinguished by their denser contents, which finally pass over into zoospores. These zoospores pass through a hole in the upper wall; and a comparison of Millardet's fig. 31 with my figs. 42 and 49–52 is very suggestive. The liberated zoospores only move for about five minutes, and, after coming to rest, produce disks with orange-red contents as before. The law of growth is as described for *Coleochæte* &c.; and the cell series can be separated, forming loose branching filaments. On p. 46 Millardet states that he once only discovered an oogonium-like globule on a short pedicel inserted into the thallus.

Viewed in the light of the described facts, I think we may probably expect that subsequent discoveries will establish a group of organisms having a similar relation to the

* Ann. des Sc. Nat. sér. 5^{e}, tom. xvii. p. 45, and tom. xix. p. 315. Bornet also points out that Kützing (Tab. Phyc. pl. 97, vol. iv.) figures *Chroolepus moniliformis* with Fungus-hyphæ invading it.

† *Loc. cit.*, and Sachs, Text-book, p. 329. ‡ *Loc. cit.*

§ Ann. des Sc. Nat. sér. 5^{e}, tom. xix. p. 315.

‖ Mém. de la Soc. des Sc. Nat. de Strasbourg, tom. vi. 1870, p. 42.

¶ De Bary also allowed me to see the specimen of *Phyllactidium* found by Mettenius on *Trichomanes elegans* from Brazil. It is simply referred to by Mettenius (Abh. der math.-phys. Cl. der königl. sächs. Gesellsch. der Wiss. xi. p. 464) as a *Coleochæte*-like form on Ferns.

filamentous Chroolepidæ, that *Coleochæte scutata* has to its simpler allies, and that the so-called genera "*Phyllactidium*," "*Phycopeltis*," and "*Mycoidea*" will be found allied in other respects besides habit and mode of growth.

Conclusion.

In the foregoing essay I have attempted to place on record all the facts obtained with respect to the structure and development of a so-called "Epiphyllous Lichen," and to draw those inferences which seem to me warranted by the knowledge gained by the observations made during various periods extending over two years or so.

I claim to have established beyond reasonable doubt, and on independent grounds, that the mature Lichen is a compound organism, consisting of an Alga which furnishes the "gonidial" layer, and of a pyrenomycetous Fungus, which invests the Algal thallus, and obtains its chief nourishment from the starch &c. contained in the cells of the latter. The value of the investigation as a critical test of the modern theory of Schwendener and De Bary * respecting the nature of Lichens generally, may be regarded variously according to the views held by different readers; but it appears incontestable that the following statements are true so far as the organisms here examined are concerned.

An Alga, allied in important respects to *Chroolepus*, flourishes on the leaves of *Michelia* &c., and is undoubtedly an autonomous form. Its existence may be wholly independent, and its processes of vegetative and reproductive life carried on from one generation to another; or it may become the slave and, finally, the prey of a Fungus-mycelium, in the meshes of which it lives for some time. The fact that the exact relation of both Alga and Fungus to the substratum and to one another can be followed in detail by cultivations and sections through the whole, enables one to follow the building-up (so to speak) of the final structure, the "Lichen," without a shadow of doubt.

But it is conceivable that objection may be made, to the following effect:—It is admittedly proved that the body which results consists of an Algal thallus enslaved and preyed upon by a parasitic Fungus; but it is not proved that the final structure is a Lichen in the proper sense of the term. Such argument has been used with respect to Collemaceæ &c. One can only leave those who hold such views to extricate themselves from the difficulties into which such modes of thought unavoidably lead them. It is undeniable that a lichenologist would accept and classify the structure I have described as a "Lichen," if attention were only paid to its anatomy †. It is worse than useless, therefore, to argue that because the "hyphal" and "gonidial" elements are capable of separate existence as autonomous forms it is not a Lichen. This being

* *Cf.* Schwendener in Nägeli's Beiträge zur wiss. Bot., Heft ii., iii., iv., and De Bary, Morph. u. Phys. d. Pilze, Flechten, &c; also summary of the whole question in Quart. Journ. Micr. Sci. vols. xiii. and xiv. Mr. Vines gives an excellent summary of more recent details in Quart. Journ. Micr. Sci. April 1878; and the now copious literature is quoted in the three papers last named.

† Dr. Nylander and the Rev. J. M. Crombie have since done this. These authorities name the Lichen *Strigula complanata*, Fée, with var. *stellata* (the branched form).

so, we may proceed to inquire into the position of the Lichen from the point of view of the systematist.

The structure of the "thallus," and the relative positions of the main masses of the Fungal and Algal portions, agree with what occurs in heteromerous crustaceous Lichens, such as the Graphideæ; but the perithecia indicate an Angiocarpous alliance, bringing this form nearer such families as Pertusariæ and Verrucariæ, to the latter of which it may ultimately be referred.

A few remarks may be pertinently introduced here as to the possible light now thrown on such aberrant forms as "*Strigula*," "*Cephaleurus*," &c.* I have not been able to examine original drawings or preparations of these forms; but every thing points to the probability that the old genus "*Strigula*" includes the "Lichen" I have described, while the form "*Cephaleurus*" (which has been associated, I believe, with *Strigula*) is simply the Alga studded with its barren and "fertile" hairs (Pl. XIX. figs. 15 & 16). At figs. 80 & 81 of the Rev. M. J. Berkeley's 'Introduction to Cryptogamic Botany' are some drawings which may throw unexpected light on this question. The asci and spores figured are suggestive of those shown in my Pl. XXI. figs. 66 & 68 †; and the small sketch of a thallus and perithecium bear out this view, which becomes rendered sufficiently evident by Berkeley's fig. 81 to admit of our acceptance that the Lichen which I have described is a species of "*Strigula*," of the old group Limborei, probably a section of Verrucariæ ‡. In conclusion, I would earnestly recommend an exact study of some of the points raised above to those botanists who have opportunities in the tropics. The whole group of "Epiphyllous Lichens" would no doubt well repay prolonged and careful investigations.

DESCRIPTION OF THE PLATES.

Plate XVIII.

Fig. 1. Shoot and leaves of *Michelia fuscata*, on which the epiphyllous Lichen is seen in all stages of development. The orange-red patches consist of the *Alga* alone. The green and grey patches, with small black dots in them, are early stages of the *Lichen*. Their colour varies according to the predominance of the *hyphæ* or the *Algal thallus*. The complete *Lichen* is represented by the white porcellaneous patches. All natural size.

Fig. 2. Four of the orange-red patches removed from the leaf, and showing the general external characters of the *Alga*: *a*, nat. size, and much branched; *b*, similar thallus examined with a simple lens, and showing the crowds of "fertile hairs;" *c*, portion of a thallus more magnified (Gundl. $\frac{1}{3}$, oc. 2), and studded with "barren hairs." The specimen *c* was not so finely branched as the others. All transitions between these types and rounded forms exist side by side.

* See Berkeley, Introd. to Crypt. Bot. 1857, p. 390.

† In Mr. Berkeley's sketch are three and four spores respectively in the two asci; possibly no account was taken of the numbers.

‡ *Vide* Luerssen, Med. Pharm. Bot. i. p. 212.

Fig. 3. Specimens of the adult *Lichen* slightly magnified. The upper consists of two unbranched thalli; the lower figure represents one much branched. The dark spots in the white porcellaneous matrix are fruit-bodies.

Fig. 4. Portion of a grey-green thallus removed from the leaf. In connexion with the *Alga* are *Fungus-hyphæ*, some of which radiate from points at the edges. Two black *pycnids* have also been formed in the substance of the thallus; and from the apical pore of one of these minute colourless *stylospores* are escaping. Gundl. $\frac{1}{8}$, oc. 4.

Fig. 5. Portions of the alga more closely examined. The thallus consists of radially arranged rows of cells and of prolongations of these. Each cell contains a general matrix of green-coloured protoplasm, in which are granules and oily drops, some of which are coloured red and orange: *a*, fresh, in water, Zeiss D, oc. 2; *b*, ditto, Zeiss E, oc. 4; *c*, decolourized in alcohol and glycerine, Zeiss D, oc. 4.

Fig. 6. Portions of similar thallus. The oily orange-coloured globules are more or less diffused or in abeyance (*a*), or form large drops (*b*) in the firm-walled cells; in (*c*) they have become disorganized, and colourless resin-like bodies are formed. Fig. 6 *d* shows a not uncommon example of the loose branching of the thallus. Fig. 6. Zeiss J, oc. 4; *b* & *c*, Zeiss E, oc. 4; *d*, Zeiss D, oc. 4.

Fig. 7. Portion of vertical section through a leaf of *Michelia* and its superposed Alga; the razor has passed through the tip of a branch of the latter where two "barren hairs" arise. Acetic acid and glycerine. Zeiss D, oc. 4.

Fig. 8. Similar section, passing through a broader portion of thallus and its *rhizoids*: the upper "palisade cells" of that portion of the leaf covered by the thallus are becoming divided by horizontal septa, as a cork meristem. Alcohol and glycerine. Zeiss D, oc. 4.

Fig. 9. Similar section through leaf and body of Alga: cork meristem &c. as before. Decolourized in alcohol, and treated with KHO. Zeiss D, oc. 4.

Plate XIX.

Fig. 10. Similar sections through leaf, the thallus (in *a*) and details of cell-contents omitted for simplicity: at *b*, through portion of leaf not affected by the epiphyte; *a*, through portion on which the Alga had developed. In the latter the palisade cells have developed cork meristem, the outer cells being already brown and dead; in the deeper cells the divisions are more irregular. Zeiss D, oc. 4.

Fig. 11. Portion of thallus, from section similar to last: it is external; and the rhizoids are closely compressed. Zeiss E, oc. 4.

Fig. 12. Similar section through leaf and more loosely grown thallus, showing the rhizoids and cuticle of of the latter in detail; the razor has also exposed a young zoosporangium. The cuticle and epidermis of the leaf are dead; but the rhizoids have not penetrated the leaf. Imm. $\frac{1}{10}$, oc. 3.

Fig. 13. Vertical section through leaf of *Citrus*, on which the Alga is flourishing. The latter has developed in the epidermis, pushing up the cuticle and breaking down the cells. Deep down in the palisade cells, horizontal partitions have formed, resulting, as before, in the formation of dead corky tissue. All healthy growing parts are left uncoloured. Two "barren hairs" are protruded through the cuticle. Zeiss E, oc. 4.

Fig. 14. Portion of cork and cork meristem from section similar to last, treated with $H_2\,SO_4$ and iodine solution and washed. The cork remains yellow-brown and resistant, the meristem walls become blue, swell up, and finally dissolve.

Figs. 15 & 16. Portions of Alga-thallus, viewed obliquely from above (Hartn. 4), to show the relations of the "barren" and "fertile hairs" to the cellular thallus. In fig. 16 are also shown the zoosporangia in the thallus. The outlines and relations of parts are accurately drawn; but the filling-up of the cell series in the thallus is somewhat diagrammatic.

Figs. 17 & 18. Portions of Alga-thallus removed from the leaf and viewed from below in glycerine. The branched rhizoids are seen spreading in all directions from the under surface. Fig. 17, Zeiss D, oc. 4; fig. 18, part of same, Zeiss J, oc. 4.

Fig. 19. Portion of edge of thallus, showing cuticle and thick-walled flattened rhizoids. Zeiss J, oc. 4. Fig. 19 *a*. Under view of a zoosporangium with three appressed rhizoids developed from surrounding cells. Zeiss J, oc. 4.

Fig. 20. Barren hairs, showing their simple composition as rows of cylindrical cells, with orange-red contents. Zeiss D, oc. 4.

Fig. 21. Two "fertile hairs," similarly constituted to the above, but with the apex developed into a tuft of zoosporangia, the base dilated and thickened. Zeiss D, oc. 2.

Fig. 22. A tuft of zoosporangia, through which the axis of the "fertile hair" has grown forwards and again formed a secondary tuft. Zeiss D, oc. 4.

Fig. 23. Abnormally developed fertile hairs. In *a* the main axis had been broken off, and a side branch formed, the end of which proceeds to form a tuft; *b*, the end of the main axis, having formed the swelling, is prolonged forwards. Zeis D, oc. 4.

Plate XX.

Fig. 24. Normal development of the apex of the fertile hair to form the tuft of zoosporangia. The end swells up (*a* to *c*), and protrudes pairs of short branches (*d*), which then develope zoosporangia at their ends (*e*, *f*). The orange-red contents not depicted. Zeiss. D, oc. 4.

Fig. 25. Base of "fertile hair," showing the lamellation of the very thick cell-wall. Zeiss J.

Fig. 26. Cell from middle of a "fertile hair," showing processes on inside of cell-wall. Zeiss E, oc. 4.

Fig. 27. "Barren hairs" of the thallus, to which fungoid hyphæ and zoospores have become attached and are commencing to develope. Zeiss D.

Figs. 28 & 29. The tuft of zoosporangia, showing origin and insertion of the supporting pedicels, and the annular attachment to the sporangia. Zeiss D.

Fig. 30. A young zoosporangium on its curved pedicel; the sporangium already open by a terminal pore. Zeiss J.

Fig. 31. More advanced zoosporangia, the contents of which are already broken up into zoospores, and the papilla formed: *b* was drawn one hour after *a* (in water); *c*, 12 hours later. Imm. $\frac{1}{10}$.

Figs. 32 & 33. Empty sporangia, from which zoospores have escaped. Zeiss J, oc. 4.

Fig. 34. Nearly mature zoosporangia treated with H_2SO_4 and iodine; the cell-wall swells and discloses laminæ, and becomes coloured blue.

Figs. 35 & 36. Emission of the zoospores from the ovoid sporangia; they come out singly and form groups. Each is a subgloboid orange-coloured body with two long cilia; many swell and burst (*a*) on coming to rest, scattering numerous colourless minute granules.

Fig. 37. Group of zoospores come to rest; each rounds off, loses its cilia, and develops a membranous envelope and a nucleus-like body. Zeiss J.

Fig. 38. Similar group just before coming to rest. Zeiss E, oc. 4.

Fig. 39. Portion of main body of Alga-thallus, showing radiating arrangements of cell series, and two young zoospŏrangia; each of the latter is the modified end cell of a series, and is filled with oily and granular orange-red protoplasm. Zeiss E, oc. 4.

Fig. 40. Figures to illustrate the above more fully: *a* is accurately drawn as regards the cell-divisions; *b* represents what would be if the cell series were laterally detached, a condition sometimes found naturally. *a*, Zeiss E, oc. 4.

Fig. 41. Portion of thallus-margin, showing relation of radial rows of cells to the outline and zoosporangium. Gundlach $\frac{1}{8}$.

Fig. 42. A zoosporangium just before the emission of zoospores: on the upper surface is a circular hole, slightly elevated, through which the zoospores come out. Zeiss E, oc. 4.

Fig. 43. Portion of thallus with empty or nearly empty zoosporangia: *a*, seen from above; the two empty zoosporangia present slit-like openings; *b*, from below; four zoospores were actively moving inside the sporangium, which is surrounded by rhizoids. Zeiss J, oc. 4.

Fig. 44. Outlines of the upper surface of two zoosporangia, showing the double nature of the opening. The irregular slit in the upper membrane, the cuticle, discloses the round pore of the zoosporangium-wall beneath. Zeiss J, oc. 4.

Figs. 45, 46, & 47. Zoospores in various stages after emission. Each comes out with rapid jerks, and is fusiform in shape; then it swings round and round, trailing one cilium, the body becoming more oval or subglobular; finally it rounds off as it comes to rest, the cilia becoming coiled back on themselves and finally absorbed. Many swell and burst, scattering the brilliant granules. All but one group imm. $\frac{1}{10}$; the small group Zeiss D, oc. 4.

Fig. 48. Group of young disks of the Alga. The smaller ones are zoospores some hours after coming to rest; in the larger specimens cell-divisions are already established. Imm. $\frac{1}{10}$.

Plate XXI.

Fig. 47. For this series see above, Pl. XX.

Figs. 49 & 50. Similar very young thalli, the cells of which have acquired the orange-red pigment in quantity; in very wet weather such specimens become green. Zeiss J, oc. 4.

Figs. 51 & 52. Older specimens of thallus, showing mode of division of the cells; in all these cases the division-walls are drawn exactly to scale as seen: *a*, Zeiss D, oc. 4; the rest, imm. $\frac{1}{10}$.

Fig. 53. Diagrams to illustrate the law of cell-division and growth followed by the Algal disk; the advances in complexity consist in bipartitions of the existing cells by vertical radial walls, followed by the insertion of tangential septa. The tendency of the new walls to abut on the old ones at angles approaching the vertical is remarkable.

Fig. 54. Two zoospores of the Alga come to rest, have acquired an apple-green colour and thin membranous envelope, and are in process of being attacked by Fungus-hyphæ developed from a spore. Such cases are common on the surfaces of leaves in wet seasons. Imm. $\frac{1}{10}$.

Fig. 55. Zoospores come to rest, and becoming divided and invaded by a Fungus-hypha; several have already lost their coloured contents. Imm. $\frac{1}{10}$.

Fig. 56. An Alga-thallus attacked by the Fungus at an early stage; only five cells of the Alga retain their colouring-matter. The Fungus-hyphæ are spreading, and have formed a dense mass of conidia. Imm. $\frac{1}{10}$.

Figs. 57 & 58. End of a branch and part of margin of an older thallus invaded by the Fungus; many cells have lost their contents, and become modified in growth, and the hyphæ are now spreading around, branching and anastomosing one with another. Fig. 57, Zeiss D, fig. 58, E.

Fig. 59. The fungus hyphæ on the surface of the Alga, and spreading from its edges as it penetrates beneath. The hyphæ follow very closely the divisions between the cells, especially the radial walls; as they pass off their walls lose the dark colour. Imm. $\frac{1}{10}$.

Fig. 60. A pycnidium formed on the surface of the Algal disk, at the junction of many radiating hyphæ; several stylospores have escaped from the apical pore. The orange-red colouring-matter is still seen in the cells, along the dividing walls of which the hyphæ course. Zeiss E, oc. 4.

Fig. 61. Portion of mycelium detached, showing the nature of the jointing, branching, and anastomoses. Imm. $\frac{1}{10}$.

Fig. 62. Portion of Lichen after the Fungus has completely invested the Alga and has formed several pycnidia. The sea-green tint is due to the green colour of the Algal cells shining through the masses of hyphæ; the cuticle is observed at the edges, and the faintly marked radial shading follows from the mode of growth &c. Gundlach $\frac{1}{3}$.

Fig. 63. A separated pycnidium, with its immediate mycelium and apical pore. Zeiss E.

Fig. 64. Vertical section of the Lichen-thallus, passing through two pycnids. One is cut in the median plane, and stylospores are escaping through the apical pore; the other is cut much on one side, and the felted walls are exposed. Passing from the pycnidia are interwoven hyphæ, which have raised up the Alga (the cells of which contain green and red pigment) and formed a dense cushion of air-containing tissue between it and the epidermis of the leaf. Over the Alga is a distinct cuticle. Zeiss D, oc. 4.

Fig. 64 *a*. Stylospores in various stages of development. Zeiss J.

Fig. 65. Vertical section through the Lichen-thallus and part of a pycnid, with young stylospores developing on its walls. The Alga, as before, upraised by dense feltwork of hyphæ containing air in the interstices. Zeiss E.

Fig. 66. Vertical section through the perithecium and thallus of the Lichen. Asci and paraphyses radiate inwards from the wall of the perithecium; and the spores escape through an apical pore; other details much as above. Zeiss D, oc. 4.

Fig. 67. Germinating spores of the Lichen. Zeiss J.

Fig. 68. Asci and spores from the perithecium, mingled with paraphyses (*a* & *b*). At *d* the swelling and introversion of the lining of the ascus is shown: *a*, Zeiss D; *b*, E; *c* & *d*, imm. $\frac{1}{10}$.

Figs. 69 & 70. Very thin vertical sections of the Lichen-thallus, highly magnified (Zeiss L immersion), showing details of the hyphal network among the rhizoids of the Alga; the cells of the latter still retain their green and orange pigment, and a distinct cuticle (displaced in fig. 70) covers all. In fig. 70 are seen transverse sections of three hyphæ above: *cf.* also fig. 65.

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TROPICAL EPIPHYLLOUS LICHEN.

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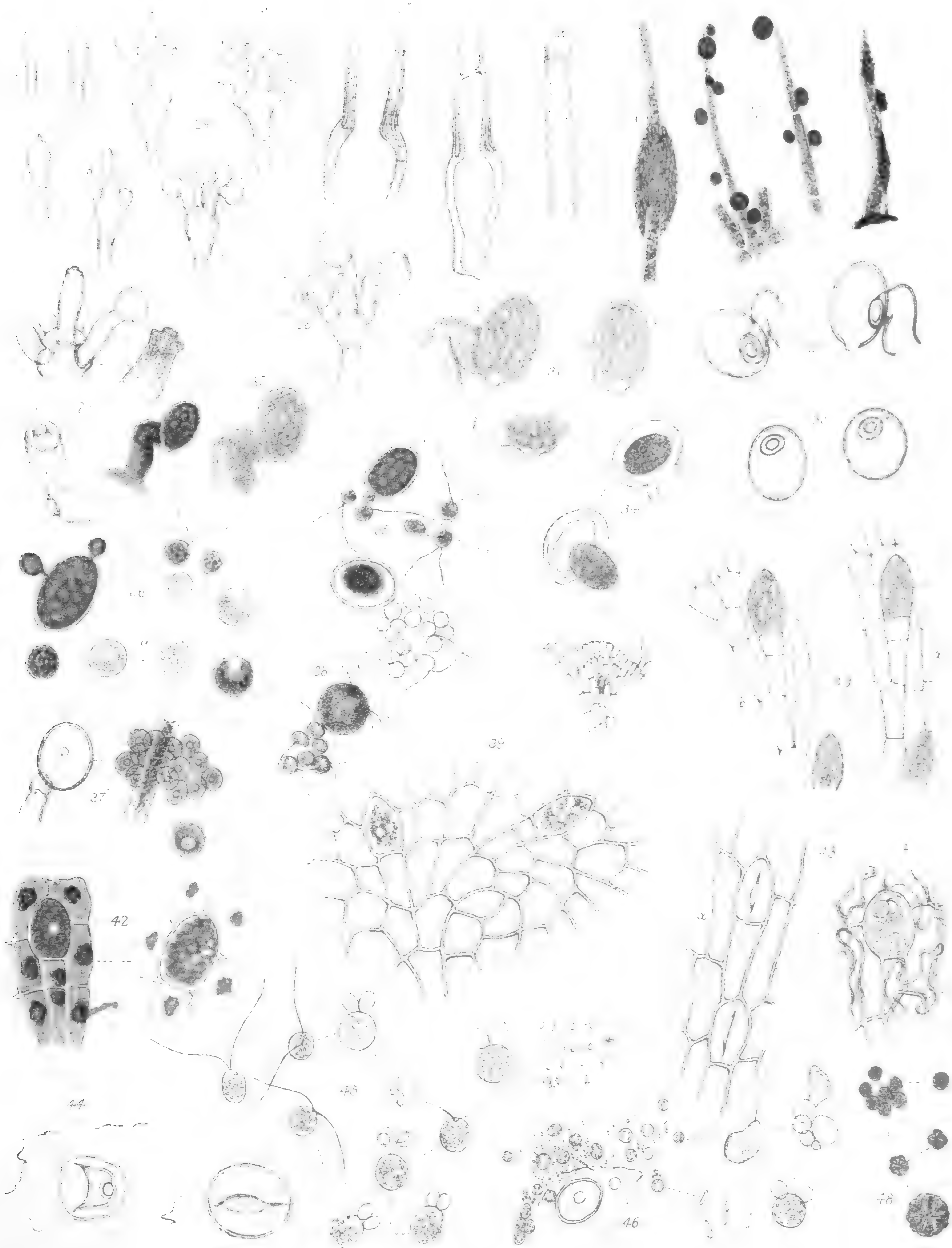
TROPICAL EPIPHYLLOUS LICHEN.



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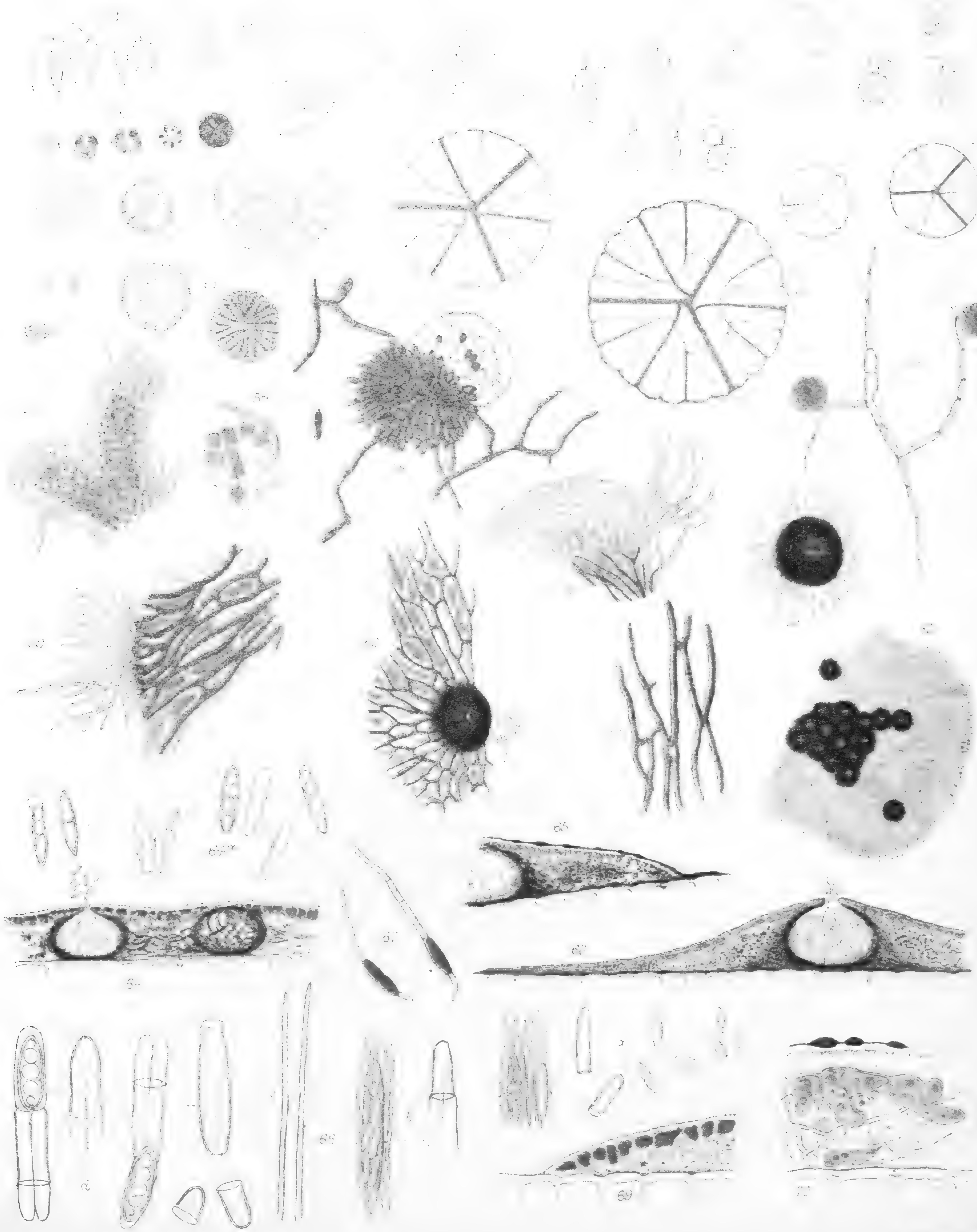

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II.	Part I.	1881	0	12	0	0	9	0
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[VOL. II. PART 7.

THE

TRANSACTIONS

OF

THE LINNEAN SOCIETY OF LONDON.

THE CYPERACEÆ OF THE WEST COAST OF AFRICA

IN THE

WELWITSCH HERBARIUM.

BY

HENRY N. RIDLEY, M.A. Oxon., F.L.S.,

ASSISTANT DEPARTMENT OF BOTANY, BRITISH MUSEUM.

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VIII. *The* Cyperaceæ *of the West Coast of Africa in the Welwitsch Herbarium. By* HENRY N. RIDLEY, *M.A., Oxon., F.L.S., Assistant Department of Botany, British Museum.*

(Plates XXII., XXIII.)

Read February 7th, 1883.

IN the collections made by Dr. F. Welwitsch in West Tropical Africa, chiefly in Lower Guinea, between the years 1853 and 1861, there are no less than 159 species of Cyperaceous plants, belonging to 16 genera. Of the genera thus represented, 11 are distributed over the tropics of both hemispheres, viz. *Cyperus*, *Kyllinga*, *Heleocharis*, *Fimbristylis*, *Scirpus*, *Fuirena*, *Hemicarpha*, *Lipocarpha*, *Rhynchospora*, *Remirea*, and *Schœnus*. Two occur besides only in America, viz. *Dichromena* and *Ascolepis*; and the remaining two are confined to Africa and the adjacent islands.

The absence of the broad-leaved Cyperaceæ, such as *Hypolytrum* and *Mapania*, is to be noticed; it is probably due to the want, for the most part, of the dense damp forests, such as occur further north in Upper Guinea.

The genus *Carex* is also conspicuously absent; indeed the Carices seem to be entirely absent from West Africa, although they are well represented at the Cape and along the east coast.

The genus *Cyperus* contains the largest number of species, viz. 71. Of these 39 are confined to Africa and the adjacent islands, 8 occur also in South America and the West Indies, and 10 are Asiatic species; the remaining 14 are distributed, more or less abundantly, over the tropics of both hemispheres. *Kyllinga*, a typically African genus, is represented by 10 species, of which 5 are endemic; 2 occur also in South America, a variety of one of which having also been collected at the Philippines, and 3 are natives of India.

Heleocharis, a genus of world-wide distribution, but most extensively developed in South America, supplies 4 species, 3 of which are common tropical and subtropical plants, while one is an undescribed species, with affinity to a South-American plant. *Dichromena* is represented by the only Old-world species which occurs also in South America, the genus being typically American. Of the genus *Fimbristylis* there are 23 species, 6 belonging to the section *Eufimbristylis*. These are all common tropical plants. The remaining 17 belong to the section *Oncostylis*, 14 of which are endemic. One, *F. barbata*, occurs also abundantly in Asia, another is spread over the tropics of both hemispheres, and one, *F. hispidula*, Kth., abundant in Africa, is met with also in S. America, and has spread into Southern Europe. *Scirpus*, the most truly cosmopolitan genus of Cyperaceæ, is represented by 8 species, 2 of which are among the most widely spread of plants, viz. *S. fluitans*, L., and *S. maritimus*, 2 are natives also of South America and the West Indies, and 2 are Asiatic, the 2 other species being found also respectively in Madagascar and Natal.

Of *Fuirena* there are 5 species, 3 of which are endemic and 2 Asiatic. Two out of the three described species of *Hemicarpha* are also in the collection, one also an Asiatic, the other an American plant. *Lipocarpha* is represented by 6 species, 2 of which are common to the tropics of both worlds; the remaining 4 are hitherto undescribed. The *Rhynchosporæ* are poorly represented. There is one common *Rhynchospora, R. aurea,* Vahl, the only known species of *Remirea,* an almost cosmopolitan sea-shore plant, and an undescribed species of *Schœnus,* differing remarkably from any other in that polymorphic and somewhat heterogeneous genus.

Of the Hypolytreæ there are 6 species of *Ascolepis,* an almost exclusively African genus, all endemic.

Of Cryptangiæ there is a single species of *Acriulus,* the only other described species being a native of Madagascar. Of Scleriæ there is 1 species of *Eriospora,* an endemic genus, and 17 species of *Scleria,* 14 of which are confined to Africa and its islands, the remaining 8 being South American.

Thus out of the whole collection, 82, or more than half, are exclusively African, or extend also only into Madagascar; 19 are natives also of Tropical Asia; while 17 are only known elsewhere from America. The remaining 32 species are widely spread and common plants. These latter consist for the most part of (α) weeds of cultivation, *e. g. Cyperus aristatus,* Rottb., *C. rotundus, Fimbristylis squarrosa*; (β) littoral plants, *e. g. Cyperus lævigatus,* L., *Remirea maritima,* Aubl., *Scirpus maritimus,* L.; (γ) river-side plants, as *Cyperus articulatus,* Kth., *Scirpus fluitans, Heleocharis palustris,* L.

But the most striking feature of the distribution of these plants consists in the large proportion, about $\frac{1}{9}$, of the species confined to Tropical Africa and South America, and the West Indies, but not occurring in Asia; nor is this proportion altered if, in addition to the plants here enumerated, we add all the Cyperaceæ known from Tropical Africa. Thus out of 220 species of African Cyperaceæ, 27 species are met with also only in America. Among these plants are included *Cyperus flavescens,* L., which is abundant in both South America and Africa, extending also into Europe and as far east as Afghanistan, and *Kyllinga cæspitosa,* Nees, of which a variety is recorded from the Philippines*. With respect to the former plant, it may be noted that all the European species of *Cyperus,* with the exception of two or three endemic ones, are natives also of Tropical Africa, only those occurring in Tropical Asia which are cosmopolitan. The same remarks apply to the genera *Fuirena* and *Fimbristylis,* plainly showing the origin of the tropical element in the European flora.

It may not be out of place here to give a list of the species of Cyperaceæ common to the two continents of Africa and America, but not occurring in Asia, as far as they are known.

Cyperus flavescens, L. All Africa.
olfersianus, Kunth. Congo (Christian Smith in Herb. Brit. Mus.).
seslerioides, H. B. K. Lower Guinea.
dichromenæformis, Kunth. Lower Guinea.

* This may be an introduction from America, for I learn from Señor Vidal that there are in the Philippines several plants introduced from Mexico after its conquest by the Spaniards; with which this may have come.

Cyperus sphacelatus, Rottb. Upper and Lower Guinea.
lætus, Presl. Lower Guinea.
ligularis, L. Upper and Lower Guinea and adjacent islands.
flabelliformis, Rottb. Abyssinia, Lower Guinea.
dissolutus, H. B. K. Upper Guinea.
ferax, A. Rich. Guinea, Zambesi.
thyrsiflorus, Jungh. Lower Guinea.
flavus, Boeckeler. Guinea.
Kyllinga obtusata, Presl. Lower Guinea.
vaginata, Lam. Upper Guinea, Cape Verd Isles.
cæspitosa, Nees. Lower Guinea.
odorata, Vahl. Upper Guinea.
Dichromena candida. Upper and Lower Guinea.
Fimbristylis hispidula, Kunth. All Africa.
Scirpus spadiceus, Boeckeler. Upper and Lower Guinea.
cubensis, Kunth. Nile Lands, Lower Guinea.
filamentosus, Vahl. Upper Guinea.
Hemicarpha subsquarrosa, Nees. Lower Guinea.
Ascolepis brasiliensis, Benth. Upper Guinea.
Scleria hirtella, Sw. From Upper Guinea to the Cape.
macrocarpa, Salzm. Lower Guinea.
verticillata, Muehlb. Upper Guinea, Central Africa.
flagellum, L. Guinea.

Of these 28 plants 3 have been recently discovered on the high lands of Central Madagascar, viz. *Cyperus ligularis*, *Dichromena candida*, and *Scleria hirtella*, none of which, with the single exception of the last named, occur in South Africa. It is to be noted also that it is on the west coast of Africa that most of these plants have been found.

Thus there appears to be a very remarkable connexion between the flora of West Tropical Africa and that of South America and the West Indies. When, however, we come to examine the distribution of the other orders of plants and animals of Africa, so as to compare it with that of the Cyperaceæ, we shall notice a remarkable difference. Taking, for example, the higher orders of Dicotyledonous plants, as set forth in the 'Flora of Tropical Africa,' we find that out of 412 plants, only 7, or $\frac{1}{59}$, are common to the two continents only, as opposed to $\frac{1}{9}$ of Cyperaceæ; that is, that the number of higher plants occurring in both Africa and America, but not in Asia, is less than $\frac{1}{7}$ of that of the lower. Wallace ('Distribution of Animals,' vol. i. chap. xi.) seems to consider that there is no evidence as to the former connexion of the two continents, and says (p. 287), "The numerous cases of close similarity in the insect forms of Tropical Africa and America seem to indicate some better means of transmission, at a not very remote epoch, than now exists. The vast depth of the Atlantic, and the absence of corresponding likeness in the vertebrate fauna, entirely negative the union between the two countries." He further suggests that there may have been a moderate extension of the shores, and that this, with large islands in place of the Cape Verd Islands, St. Paul's Rocks, and Fernando Noronha to afford resting-places, would probably suffice to explain the similarity that exists. Now though this might be sufficient as regards the insects, possessed as they are with means of flight, it cannot be considered satisfactory in the case of these Cyperaceous plants. They have no means of transmission, nor are they plants likely to have been introduced by man; and further, if the list given above be examined, they will be found to be almost entirely forest-loving plants, of all plants the least likely to be drifted across the ocean by currents.

Th. Studer, in ‘Beiträge zur Meeres Fauna von W. Afrika,’ in comparing the marine animals of the west coast of Africa with those of South America, states that out of 20 species of Echinodermata collected in Africa, 17,—of 277 species of fish, 55,—and of 541 Gasteropoda, 54 occurred on the American coast also. To account for this, he suggests that the young of these animals may have been carried across the sea by currents, and cites the case of the *Sargassum* of Florida being drifted across to the Cape Verd Islands. This is possibly the cause; yet it is singular that the largest proportion of species common to the two coasts, 85 per cent., is to be found in the Echinodermata, the oldest group of the three, and at the same time one that seems least able to make its way across the ocean; while in the later-developed Fish, which have far greater facilities for crossing the ocean, only 20, and of Gasteropods, whose eggs are frequently attached to seaweed and other floating objects, and might so get across, only 10 per cent. are common to both coasts. Now taking these facts into consideration, and remembering also that the insects, which Wallace admits have a certain number of species in common on both coasts, are an order of very great antiquity, it seems to be very probable that there was at some time in the world's history a complete connexion between Africa and South America, at about which time Africa was also connected with Madagascar, and that the Cyperaceæ above mentioned are the relics of the flora of that period.

It may be premature to endeavour to assign a date to this flora; but it is probable that it existed prior to the Miocene period, since Wallace, *l. c.*, has shown from the distribution of the Mammalia, that there was no connexion between the two continents since the incursion into Africa of the large Carnivora, which took place in all probability in Miocene times; on the other hand, since there is no genus of mammalia common to the two continents except the aquatic *Manatus*, it was probably a great deal earlier.

The Cyperaceæ are but little used by the natives of Lower Guinea in medicine or the arts. The Papyrus, according to Dr. Welwitsch, is put to a variety of uses, such as to make paper, beds, for thatching, and even for bridges. The rhizome of *Cyperus articulatus*, L., is used in medicine for allaying intestinal pains, and seems to be cultivated to some extent for that purpose. In Ashantee, according to Mr. Teddie, it is used as an anthelmintic. *C. hylæus*, an undescribed species, is used also by the natives in medicine; but for what diseases Dr. Welwitsch does not state. The tubers of *C. rotundus* and *C. esculentus*, L., though both common plants, do not appear to be used for food as they are in Damara Land and elsewhere in Africa.

SCIRPEÆ.

Cyperus (§ Pycreus) flavescens, L., Sp. Pl. p. 46.

Sierra Leone, in uliginosis juxta rivulos prope Free Town, Sept. 1853, no. 7055.

Golungo Alto, frequens in spongioso-palustribus ad marginos rivi Cuango prope Sange, socialis cum *Cypero polito*, Welw. MS. (*C. flavescens*, var. *abyssinicus*), Dec. 1854, no. 7101; in palmetis humidis humo nigro diviti prope Ponte de Luiz Simois, Jul. 1855, no. 7088.

Ambaca, non infrequens inter rivum Caringa et lacum Canguele Canganga, Jun. 1855, no. 7087–7096.

Pungo Andongo ad paludes prope Quitage, Mart. 1857, no. 6923; Umbilla, Cuanza, Muta Lucales, no. 6907, cæspitoso-gregarius ad ripas spongiosas rivi Calunda ipsius Præsidii, no. 694.

Var. *abyssinicus*, C. B. Clarke, in Linn. Journ. xx. p. 279. *Cyp. abyssinicus*, Hochst. in Schimp. Pl. Abyss. 122.

Golungo Alto, frequens, at unico loco a me visus in spongioso-palustribus prope Sange ad margines rivi Cuango, Dec. 1854, no. 7072.

Pungo Andongo, frequens ad paludes sylvaticas juxta flumen Cuanga, prope Sansamanda, Feb. 1857, no. 6922; ad ripas rivuli Casalale ipsius Præsidii, no. 6925.

The plant is very variable in habit; no. 6925 is remarkable for its flaccid green decumbent culms and leaves and diffuse panicle. The species occurs over the whole of Africa, from Algeria to Natal, also in Madeira and Madagascar, and the greater part of Europe as far east as Persia and Afghanistan, and in North and South America. The Australian plant taken for this species seems to be *C. globosus*, All.; the plant distributed by Sieber, in the *Agrostotheca*, no. 105, evidently did not come from Australia.

C. (§ Pycreus) mundtii, Kunth, Enum. ii. p. 17.

Loanda district, no. 7092. Mossamedes in spongiosis ad lacum Giraul, Jul. 1859, no. 6885.

Golungo Alto, in paludosis ad ripas rivi Casaballa, Sobati de Bumba, socialis cum *Nauclea*, Mart. 1856, no. 7092; rarior ad rivulum Cuango, aliis *Cyperaceis* dense intertextis, Jan. 1855, no. 7092.

Pungo Andongo, ad latera rivulorum prope Cabondo ipsius Præsidii, no. 6926, ad finem Martii, 1857.

Cæspitosa caulibus ascendentibus flagelliformibus inter herbas altiores quasi scandens, foliis rigidis; steriles culmi ascendentes, florigeri erecti trigoni brevissimi, spicarum pedunculi cylindrico-compressi fere ancipites. Habitus *Remireæ maritimæ*, stolones flagelliformes iis dianthorum exacte similes.

This plant appears to be confined to Africa and the adjacent islands; it is distributed over the whole continent, from Algeria to the Cape, Madagascar, and Bourbon.

C. (§ Pycreus) lanceolatus, Poir. Encycl. vii. p. 245; *C. intermedius*, Steud. Flora, 1842, p. 581.

Huilla, in arvis humidis prope Lopollo, non frequens, Mart. 1860, no. 6873.

Occurs also in Abyssinia and Madagascar.

C. (§ PYCREUS) FULVUS, n. sp. Glaucus, rhizomate repente lignoso, crassiusculo, radicibus crebris validulis ; culmis semipedalibus rigidis striatis obtuse triquetris basi dilatatis; foliis rigidis linearibus acutis carinatis, culmo brevioribus; involucralibus tribus rigidis linearibus acutis, demum patentibus basi vix dilatatis longis ; umbella plerumque congesta ; spicis pluribus, ultra viginti; ramis flexuosis triquetris brevibus, squamis ad 13, lanceolatis trinerviis carinatis breviter mucronatis lucidis fulvobrunneis ; carina viridescente, marginibus crispis anguste scariosis ; staminibus tribus breviter apiculatis; stylo bifido parum exserto; caryopsi immatura minuta.

Huilla, in humidis inter Lopollo et Eme ad oras sylvarum frequens ad finem Aprilis, no. 6872 : in agri Lopollensis arvis humidis olim dumetis juxta rivum, no. 6881.

The affinity of this plant is with *C. intermedius,* Steud. The umbel is usually compact as in that species, but where it is not, the involucral leaves spring from the base of each ramus, and do not form a whorl, as in most *Cyperi.* A similar arrangement obtains also in *C. stramineus,* Nees, etc., but less conspicuously, and it is carried to an extreme in the allied *C. divulsus,* Ridl., where the inflorescence is actually a compound spike, each flower-spike, with its subtending leaf, being sessile on the produced primary rhachis. The brown shining leaf-sheaths break up by decay, leaving the bulbous base of the stem covered by the black wiry fibro-vascular bundles. Height of culm 5–7 inches; leaves 2–5 inches high by 1 line in diameter; spikelets 4 lines in length; involucral leaves attaining the length of 2 inches.

C. (§ PYCREUS) MACRANTHUS, Boeckeler, Cyp. Herb. Berol. 66.

Huilla, in paludosis Empalanca, at rarus, April 1860, no. 6877.

A native of the Cape.

C. (§ PYCREUS) LANCEUS, Thunb. Prod. p. 19, var. *angustifolius,* n. var. Rhizomate gracili descendente aut stolonifero ; culmis bipedalibus, gracilibus ; foliis elongatis ; culmis brevioribus, anguste linearibus ; involucralibus 2–3 similibus.

Pungo Andongo, Candumba, Mart. 1857, no. 6930.

The slender leaves and rhizome give this plant a very different appearance from the typical form, which it otherwise resembles. The species is found at the Cape, and Nuer White Nile territory and Madagascar.

C. (§ PYCREUS) PAUPER, Hochst., Schimp. Pl. Abyss. no. 1602.

Ambaca ad margines camporum inundatorum inter rivum Caringa et lacum Canguela Canganga, Jan. 1857, no. 7069.

Hitherto only recorded from Abyssinia, where it was collected by Schimper.

C. (§ PYCREUS) HOCHSTETTERI, Nees, Flora, 1845, p. 755.

Loanda, in alte graminosis humidis hyeme inundatis, humo atro diviti, prope Teba, et ante Quicuxe, at paucis locis, Mai. 1854, no. 7046.

Pungo Andongo, in insulis minimis ad cataractam magnam fluminis Cuanza, prope Condo, Mart. 1857, no. 6938; frequens in dumetis, Cuanza et Caghuy, no. 6940.

Quitage, apud Cuije, no. 6940. Lagoa de Quibinda, no. 6907.

In Africa this plant has been collected in Nubia, Kotschy! Abyssinia, Schimper! Gallabat, Schweinfurth! It also occurs in Madagascar, India, Australia, and Tropical South America.

C. (§ PYCREUS) AFZELII, Boeckeler, Cyp. Herb. Berol. p. 79.

Pungo Andongo, in pratis humidis ad Catete cum *Polygala microdendron*, ad paludes sylvaticas prope Quilanga et in ipso Præsidio, no. 6919.

A native of Sierra Leone and Bongo Land. This form has very yellow glumes and almost setaceous leaves and culms. It is perhaps the variety *capillifolius*, Bckler. Flora, 1879, p. 547.

C. (§ PYCREUS) MELAS, n. sp. Cæspitosus, radicibus tenuibus; culmis gracilibus setaceis glabris vix semipedalibus; foliis setaceis vel angustissime linearibus, culmis brevioribus striatis glabris, vaginis fissis; involucralibus 1–2 gracilibus setaceis vel anguste linearibus, basi vix dilatatis demum patentibus; spiculis sæpius 5, in capitulo aggregatis linearibus, 20–30-floris; ocreis brevibus apice purpureis; rhacheola flexuosa, purpureo-punctata; squamis ovatis carinatis haud mucronatis remotiusculis lateribus atro-purpureis, marginibus apiceque scariosis, carina pallida; stylo parum exserto, breviter bifido; caryopsi oblonga basi angustata, apiculata, apicula longiuscula atra, cancellata, quam squama $\frac{1}{4}$ breviore.

Pungo Andongo, in paludosis prope Lombe cum *Cypero* altero robusto atro-rubente, Mar. 1857, no. 6913; Mutollo Sobata de Guinga cum *Irideis* pusillis et *Xyrideis*, Jan. 1857, no. 6914.

Huilla, in pascuis editis ad Morro de Lopollo versus Empalanca, locis tempore pluvii inundatis, Apr. 1860, no. 6871.

The affinity of this plant is with *C. Afzelii*, Boeckeler. The culms are from $3\frac{1}{2}$ to 6 inches in height, the longer of the involucral phylla is three inches in length. Spikelets nearly $\frac{1}{2}$ inch.

C. (§ PYCREUS) POLYSTACHYUS, Rottb. Descr. et Ic. p. 39, t. 11.

Prince's Island, in uliginosis editioribus ad Rio de Papagaio, Sept. 1883, no. 7032.

Ambriz, in paludosis sylvestribus ad austrum vici Ambriz, 1853, no. 7041.

Loanda, ad aquaria et stagna insulæ dictæ Ilha de Cazanga, ad austrum Loandæ sitæ, paucis locis socialis cum *Typha angustifolia* etc., April. 30, 1854, no. 7081.

Mossamedes, in paludosis prope Aguadas non procul Mossamedes, Jul. 1859, no. 6890, in humidis ad ripas fluminis Caroca (vulgo Croque) prope Cabo Negro, Sept. 1859, no. 6891.

Pungo Andongo, in pratis paludosis cum *Ascolepidibus*, no. 6927.

Golungo Alto, frequens in humidis spongiosis ad ripas rivuli Quiapose, prope Sange, Jan. 1855, no. 7100.

A cosmopolitan plant, common in Africa from Algeria to the Cape.

C. (§ PYCREUS) FLUMINALIS, n. sp.; rhizomate descendente, culmo singulo erecto sesquipedali striato triquetro; foliis linearibus rigidis complanatis carinatis scabris glaucis, culmo dimidio brevioribus, patentibus, vaginis truncatis; capitulo singulo, phyllis involucralibus 4 linearibus glaucis patentibus uno 4-unciali; spiculis multifloris linearibus, 5-linealibus; rhacheola recta, foveolis brevibus oblongis; squamis lanceolatis, brevissime mucronatis albis, dorso pallide sanguineo-punctato; stylo bifido parum exserto gracili; caryopsi ovata lenticulari fusca, transversim rugosa, mucrone longiusculo.

Pungo Andongo, rarius, ad ripas fluminis Cuanza prope Candumba, in ipsius fluminis agris, socialis cum *Arundinibus*, *Pandanis* et *Filicibus*, no. 6897, Jun. 1857.

This seems most nearly related to *C. polystachyus*, L., of which it has very much the habit.

C. (§ PYCREUS) LÆVIGATUS, L., Mant. 179.

St. Vincent's Island, Cape Verd, Monte Verde, at an elevation of about 1000 feet by half dried-up streams, at the end of August, no. 7075.

Mossamedes, in paludosis prope Aguadas prope Mossamedes, no. 6858; in subsalsis prope os Cazados, no. 6857; prope Cavalheiros, in arenosis ad flumen Bero, no. 6856; in arenosis ad ripas ad flumen Caroca, Cabo Negro, no. 6855.

A cosmopolitan plant widely distributed over Africa.

All the specimens belong to the white-glumed variety, except a specimen under the number 6858, which has fuscous glumes; no. 6855 is a very small form, 1–2 inches high, with single spikelets.

C. (§ PYCREUS) PUSTULATUS, Vahl, Enum. ii. p. 341.

Pungo Andongo, ad paludes parum profundas inter Præsidium et Quilanga, Febr. 1857; ad ripas Casalale, no. 6918.

In graminosis prope domum Rodrigo, rarus, Febr. 1855, no. 7090 (ac no. 7156, loc. ?).

Occurs also in Upper Guinea, Senegal, and Nupe.

C. (§ PYCREUS) CUANZENSIS, n. sp.; rhizomate breviter repente radicibus crebris crassiusculis; culmis flaccidis compressis striatis bipedalibus; foliis culmis subæquantibus flaccidis linearibus viridibus marginibus scabris, vaginis membranaceis integris striatis; capitulo uno rarius altero; involucralibus duobus, quorum uno longissimo sexunciali, viridibus flaccidis linearibus marginibus scabridis suberectis; spiculis, plus quam viginti, multifloris compressis late lanceolatis albidis; squamis lanceolatis trinerviis, marginibus crispis, carina viridescenti, lateribus albis; rhacheola recta quadrilatera, foveolis brevibus oblongis; stylo profunde bifido parum exserto; caryopsi obovata globulosa basi angustata parva nigra.

Pungo Andongo, in pratis paludosis ad flumen Cuanza, prope Huilla, Mart. 1857, no. 6899.

The affinity of this plant appears to be with *C. bromoides*.

C. (§ PYCREUS) PUMILUS, L., *C. nitens*, Vahl, Enum. ii. p. 331.

Mossamedes, in arena humida ad ripas fluminis Bero, no. 6888, Aug. 1859

Loanda, rarior, in fundo exsiccato stagnorum et ad eorum margines; prope Conçeiao ad Represa de Maghelaes. Jam defloratus Julio 12, no. 7076.

Pungo Andongo. In pratis de Catete, Umbilla Cuanza, Jan. Mart. 1857, no. 6097; ad paludes sylvaticas in apricis inter Præsidium et Quilanga, Feb. 1857, no. 6921.

Huilla, in arvis humidiusculis arenosis sub solo argillaceo frequens cum *Dicholepidibus*, Maio 1860, no. 6879 *b*; in arvis post *Sorghi* plantationes, nimis frequens prope Lopollo, no. 6854.

It occurs also in Abyssinia and Nubia, India and Malaya.

C. (§ PYCREUS) PELOPHILUS, n. sp. Cæspitosus, radicibus tenuibus; culmis sæpius pluribus patulis, subpedalibus compressis apice triquetris striatis; foliis linearibus angustis, culmis multo brevioribus flaccidis, vaginis fissis membranaceis striatis purpureo-punctatis; umbella sæpius magna diffusa, radiis valde inæqualibus, longissimo eorum 4-unciali, ocreis ore truncatis sæpius laminiferis basi purpuratis; spiculis aggregatis multifloris linearibus uncialibus patentibus; foliis involucralibus 6, linearibus flaccidis radios subæquantibus, apicibus remote spinulosis scabriusculis; rhacheola angusta flexuosa, foveolis angustis oblongis; squamis remotis ovatis lanceolatis, brevissime mucronulatis 5-nerviis flavis, carina viridi; stylo bifido tenui haud exserto; caryopsi obovata compressa brevissime apiculata, nigro-brunnea, squama $\frac{1}{3}$ breviore.

Mossamedes, in paludosis arenoso-argillaceis prope Giraul, sparsim, no. 6887.

Loanda, ad stagna exsiccata in via versus Calumba prope Cumano, initio Julii 1860; in arenosis inundatis exsiccantibus prope Bemposta, Julio 1858, no. 7025; in argillaceis stagnorum exsiccatorum prope Forte de Conçeiao satis frequens, Julio 2, 1854, no. 7082.

The caryopsis in this plant is remarkably flattened laterally, very much like the seed of an *Iris*. The spikelets in no. 7082 are falcate, owing to some injury, probably due to an insect.

C. (§ PYCREUS) ÆTHIOPS, Welw. MS. Glaucus, radicibus crassiusculis pluribus; culmis erectis pedalibus vix triquetris canaliculatis; foliis culmo duplo brevioribus rigidis linearibus angustis, acutis patentibus apice scabris, vaginis truncatis amplis minute purpureo-punctatis; foliis involucralibus 3-linearibus acutis patentissimis, basi vix dilatatis, marginibus scabridis, imo triunciali, cæteris brevioribus; radiis umbellæ inæqualibus brevibus obtuse trigonis canaliculatis, spicis oblongis, spiculis lanceolatis acutis patentibus trilinealibus; ocreis brevibus truncatis sæpius brevi lamina munitis; bractea parva lanceolata acuminata in basi spiculis infimis; squamis lanceolatis acutis atro-sanguineis, carina viridi; stylo profunde bifido, brevi, pallido, parum exserto; caryopsi (immatura) minuta squama $\frac{3}{4}$ breviore, obovata fusiformi biconvexa, mucrone longo; staminibus tribus linearibus; rhacheola subflexuosa, foveolis brevibus angustis oblongis.

Huilla, in pascuis uliginosis inter Ferrao da Sola et Jaû, unico loco sat frequens, April. 1860, no. 6875.

C. (§ Eu-cyperus) amabilis, Vahl, Enum. ii. p. 318; *C. lepidus*, Hochst. in Kotschy, Pl. Nub.

Loanda, in collinis arenosis prope Imbondeiro dos Lobos, init. Apr. 1854, no. 7083; in arenosis æstate inundatis agri Loandensis prope Represa de Luiz Gomez, Febr. 1858, no. 7024.

Barra do Bengo, in sabulosis tempore pluvio inundatis prope Quifandongo, necnon prope Cacuaco, no. 7084.

Benguella, in arenosis sylvestribus inter Serra das Bimbas et urbem Benguella, Jan. 1859, no. 6892.

Pungo Andongo, Candumba Lombe, no. 6912; in sylvis arenosis inter Caghuy et Mopopo in viciniis fluminis Cuanza, no. 6812.

Huilla in pascuis dumetosis inter Lopollo et Monino frequens, no. 6892.

"Species forsan omnium in Africa frequentissima."

It occurs over most of Tropical Africa, from Nubia to Mozambique, also in Madagascar, India, and abundantly in South America. All the Angolan specimens belong to the large form with broad leaves, var. *aurantiacus*, Boeckeler, *C. aurantiacus*, H. B. K., Nov. Gen. et Sp. i. 205.

C. cuspidatus, H. B. K., Nov. Gen. et Sp. i. p. 204.

Pungo Andongo, in pascuis ad rivulum Cazangue de Pedra Sangue; in humidis prope Pedra Cabondo; Catete cum *Polygala microdendron*; ad paludes sylvaticas apricas inter Præsidium et Quilanga, satis frequens, no. 6910; same district, 7155.

Golungo Alto, in apricis arenosis parce graminosis prope Cambondo, Dec. 24, 1854, no. 7099; in arvis post *Sorghi* plantationes frequens locis humidis, no. 6879, no. 7157, 7161.

One or two specimens, under the no. 7099, belong to the smaller form *angustifolius*, Boeckeler, *C. angustifolius*, Nees.

The plant is widely distributed over India, Malaya, China, and South America. In Africa it has also occurred at Sierra Leone and Nupe.

C. seslerioides, H. B. K., Nov. Gen. i. 209.

Frequens in dumetis et pascuis sylvestribus Præsidii, inprimis prope Quilanga et Catete, Dec. 1856, nos. 7146, 7147. "Bipollicaris cæspitula formans pascua brevigraminosa sylvestria, tempore vernali, i. e. Decembre, eximie ornans. Capitula nivea."

Hitherto only known from Mexico and the banks of the Orinoco.

C. aristatus, Rottb., Gram. p. 23, t. 6, f. 1.

Loanda, non infrequens ad stagna exsiccata in argilla durissima læte vegetans prope flumen de Conçeiao, Julio 12, 1854, no. 7078; ad stagna exsiccantia inter Bemposta et Cumana ad viam versus Calumba, Julio 1858, no. 7029, frequens circa lacum de Quicuje, no. 7031.

Benguella, in humidis arenoso-argillaceis inter rivum Cavado et flumen Catumballa jam fere penitus defloratus, Junio 1859, no. 6894.

Pungo Andongo, in paludosis inter Candumba et Lombe, Martio 1857, no. 6909; Muta Lucala, Condo, Martio 1857, no. 6909 *b*; in collinis rupestribus breviter dumetosis cum *Actinopteride radiata*, semper strictis culmis, Januario 1857, no. 6909 *b*.

Huilla, in arvis post *Zeæ Maidis* plantarum collectiones frequens, Lopollo, in hortis de Signor Kneissmann, Maio 1860, no. 6895.

A common and widely distributed tropical weed.

C. CANCELLATUS, n. sp. Cæspitosus, radicibus crebris; culmis subpedalibus triquetris canaliculatis; foliis linearibus acuminatis complanatis glabris; culmis parum brevioribus; vaginis tenuibus fissis purpureo-punctatis; involucralibus 2–3-linearibus, acutis, uno biunciali; umbella diffusa plerumque decomposita, radiis gracilibus valde inæqualibus teretiusculis, ocreis longiusculis, ore obliquis purpureo-punctatis; spiculis patentibus 1–5-linearibus trilinealibus, 15–20-floris; squamis ovatis obtusis breviter mucronatis remotiusculis squarrosis, mucrone recurvo; carina viridescente punctata, lateribus sanguineis; rhacheola tenui flexuosa, foveolis angustis oblongis; staminibus 3, filamentis longis, antheris brevissimis ovato-oblongis; stylo gracili breviter trifido rufo; caryopsi minuta subglobosa trigona, squama plus quam duplo breviore, alba cancellata.

Pungo Andongo, in spongiosis inter Muta Lucala et Lombe, March 1857; ad ripas rivulorum prope Cabondo ipsius Præsidii, no. 6916; in pascuis depressis uliginosis ipsius Præsidii, frequens in oryzetis ad rivulum Miege (Miesche) prope Caghuy, Febr. 1857, no. 6917.

Var. GRACILLIMUS. Planta flaccida gracillima; culmis tenuibus; foliis angustioribus semilineam latis; spiculis paucioribus 2–3 raro 1 vel 4, semiuncialibus, squamis pallidioribus, mucronis longioribus; ocreis fissis.

Huilla, in spongiosis breviter herbidis sylvarum mixtarum de Monino, at sparsim, initio Maii 1860, no. 6862.

Nearly related to *Cyperus flaccidus*, R. Br.*, but easily distinguished by the form of the nut, which is acutely triquetrous in that species, but much smaller, almost globose, and cancellate in this. When the white outer coat of the nut is rubbed off, the seed appears to be dull red. The leaves of the typical and common form are hardly one line in diameter; the rays of the umbel vary from about 1 line to 3 inches in length; the culms are from 8 inches to a foot high.

C. AMNICOLA, Kunth, Enum. ii. 52.

Huilla, in uliginosis exsiccatis prope Nene, Maio 1860, no. 6878.

A native of S. Africa.

* A native of Australia.

C. COMPRESSUS, L. Sp. Pl. p. 68.

Sierra Leone, in udis sylvaticis ad basin montium "Sugar-loaf Mountains," Sept. 1853, no. 7057.

Mossamedes, in humidiusculis ad horta da Naçao, Aug. 1859, no. 6884.

Loanda, in herbidis macris humidis Museque de Quicuxe, Maio 1854, et Cabo Lombo, sparsim, Aprili 1854, no. 7021; in paludum margine prope Museque de Luiz Gomes, et in humidis ad margines paludum limosorum prope Cabo Lombo, no. 7045; ad stagna subexsiccata in limosis juxta viam versus Calumba prope Cumano, ad fin. Julii 1860, no. 7026; in arenosis maritimis insulæ Cazangæ, no. 7024 *b*, pro parte.

A common tropical plant.

C. DICHROMENÆFORMIS, Kunth, Enum. ii. 26.

Pungo Andongo, frequens in subhumidis sylvaticis ad ripas fluminis Cuanza inter Candumba et Lombe necnon ad flumen Cuije, Martio 1857, no. 6901; ad fontes in rupibus editioribus Præsidii, locis umbrosissimis necnon in ipsis cavernis ad finem Novembris 1856, no. 6902.

Golungo Alto, in humidis montium de Queta ad finem Decembris 1856, et rarius ad paludum margines et in spongiosis umbrosis montium editiorum de Queta, cum floribus et fructibus Decembri medio 1855, et in decliviis montosis non procul a flumine Luinha, no. 7093; no locality, 7149.

"Folia intense viridia laxiuscula, siccata aroma *Anthoxanthi odorati* fragrantia; 'Nsambe' indigenarum (Golungo Alto)."

All the specimens are of the large form, the variety *major* of Boeckeler, which was originally described from Monbuttu. The plant occurs also in Brazil.

C. OBTUSIFLORUS, Vahl, Enum. ii. 308.

Golungo Alto, in pascuis dumetosis Sobati de Bumbo, at non frequens, Oct. 1855. Hodie frequentissimus, Dec. 1855. "Capitula albida in viridem vergentia. Herba rigida, rhizomate horizontali tuberculoso, tuberculis moniliformiter ordinatis, culmo trigono, foliis semicylindricis rigidis pungentibus. Prima stirps quæ mox post incendia vix peracta e cineribus camporum deustorum læto virore emergit."

Huilla, in pascuis dumetosis incendiis vexatis prope Nene, Febr. et Apr. 1860, no. 6906; in collinis breviter dumetosis juxta rivulum de Catumba ad finem Martii 1860, no. 6905.

* Var. β. FLAVISSIMUS, Boeckeler. *C. sphærocephalus*, Vahl, l. c. 310.

Huilla, in pascuis breviter dumetosis siccioribus prope Lopollo, rarior, init. Aprilis et Maii 1860, no. 6876.

Var. *Stylo bifido.*

Huilla, in collinis siccioribus ad lacum Ivantala, at parcissime florens ad finem Febr. 1860, 6838.

This plant differs only from typical *C. obtusiflorus* in having a two-cleft style. There are a few other recorded instances of this modification among *Cyperi*, e.g. *C. Barteri*, Boeckeler, which is a bifid-styled variety of *C. pustulatus*, Vahl, and it is by no means rare among *Carices*.

C. obtusiflorus, Vahl, is widely scattered over Tropical and South Africa and Madagascar, the variety *flavissimus* having nearly the same distribution.

C. MARGARITACEUS, Vahl, Enum. ii. 307.

Pungo Andongo, Condo Quissonde, Mart. 1857, no. 6903. Huilla, in pascuis breviter herbidis juxta sylvarum oras prope Humpata, at sparsim, ad finem April. 1860, no. 6904.

Var. MINOR, spiculis minus compressis, Huilla, in pascuis dumetosis incendio vexatis, prope Nene, no. 6906.

This form differs from the typical plant in being very stunted, with less-compressed spikelets rather crowded together, and dull reddish in colour. It has probably been affected by the grass-burning. The same form occurs in South Africa.

The plant is a native of the west coast of Africa and Madagascar.

C. ARGENTEUS, n. sp. Glaucus; rhizomate repente crasso lignoso, radicibus lanatis; culmo singulo teretiusculo, apice triquetro glabro $1\frac{1}{2}$–2 pedali, basi bulboso-incrassata; foliis rigidis linearibus longe acuminatis strictis angustis, marginibus revolutis, culmo multo brevioribus, marginibus scabriusculis, vaginis fissis; foliis involucralibus 2-linearibus acuminatis erectis demum recurvis, 2–5-pollicaribus, basi dilatatis; spiculis maximis multifloris, 5 et ultra in capitulo congestis, lanceolatis; squamis lanceolatis acutis vix carinatis multistriatis argenteis; rhacheola recta crassiuscula quadrilatera; foveolis latis quadrangulatis; stylo vix exserto profunde trifido rufo; caryopsi ovata acuta triquetra atra, squama duplo breviore.

Pungo Andongo, in collinis dumetosis inter Candumba et Muta Lucala, no. 6900.

This species is closely related to *C. margaritaceus*, Vahl, but differs in the narrow strict rush-like leaves, more than a foot in length, the dilated base of the involucral leaves, the narrower more acute glumes, and the general habit. The glumes are, like those of *C. margaritaceus*, of a beautiful silvery colour.

C. DUBIUS, Rottb. Descr. et Ic. p. 20, t. 4. fig. 5.

Loanda, in graminosis herbidis solo arenoso prope Penedo, rara, no. 6807.

Pungo Andongo, frequens in rupestribus Præsidii, locis humo divitibus e. g., prope Cazella, Dec. et Feb. 1856–57, no. 7162. In rupestribus sylvaticis prope Quilanga, una cum *Ophioglosso vittato*, no. 6802.

Huilla, in pascuis sylvaticis de Monino, no. 6804.

Distributed over Africa from Abyssinia and Accra to Natal, occurring also in the Mascarene Islands and Asia.

C. NUDICAULIS, Poir. Encycl. vii. p. 240. *Anosporum nudicaule*, Boeckeler, Cyp. Berl. Herb. 357.

Dande, circa lacus ad flumen Dande, prope Bombo, Sept. 1858, no. 7028.

Occurs also in Madagascar.

C. Lanceola, n. sp. Stoloniferus, radicibus tenuibus; culmis 1–4, plerumque brevibus triquetris tripteris viridibus; foliis late lanceolatis flaccidis viridibus, trinerviis, marginibus scabridis, basi vaginantibus; involucralibus 6–9, late lanceolatis flaccidis viridibus patentibus; radiis umbellæ longissimis triquetris striatis flaccidis decumbentibus simplicibus; ocreis uncialibus truncatis laminibus brevissimis munitis; spiculis 3, rarius 2, lanceolatis paucifloris niveis, sæpe viviparis; squamis ovatis multistriatis; stylo profunde trifido parum exserto; caryopsi ovata triquetra alba.

Pungo Andongo, paludes ad Mento do Pedro Cabondo, sed rarius, Feb. 5, 1870, no. 6896; ad rivulos rarius, Catumba, Queta et Zengas do Queta, Maio 1856, no. 7094.

Golungo Alto, ad rivulos in sylvaticis prope Canguerasange, rarior, Oct.–Nov. 1854, no. 7094.

Also collected in the Gaboon by G. Mann.

The affinity of this plant is with *C. simplex*, H.B.K. The culms are remarkably short, only 2 inches long at most, and winged at the angles; the radical leaves are 4 inches long and $\frac{3}{4}$ inch across, broad and flat, gradually narrowing to the base, where they clasp the stem; the sheathing portion has fine red veins, and the lamina has 3 prominent nerves, and several finer ones. The involucral leaves are similar, and form a conspicuous spreading whorl; they are from 6 to 9 in number. The ocreæ of the umbel-rays are an inch in length, and usually bear a distinct but small lamina. The rays of the umbel are weak and long, sometimes as much as 11 inches in length. As in *C. simplex*, the plant propagates itself partly by the development of bulbils in the spikelets. The specific name is taken from the old name of *Plantago lanceolata*, Linn., the leaves of which much resemble those of this plant.

C. sylvestris, n. sp.; rhizomate moniliformiter tuberoso crasso lignoso, radicibus tenuibus, culmo singulo sesquipedali canaliculato acute triquetro glabro; foliis linearibus-lanceolatis trinerviis viridibus culmo brevioribus, marginibus carinaque scabridis; involucralibus 5, longis erectis-patulis demum patentibus linearibus-lanceolatis, umbellæ radiis inæqualibus scabridis; spiculis congestis lanceolatis circiter 16-floris, squamis ovatis breviter mucronatis ecarinatis striatis; stylo trifido rufo exserto; caryopsi ovata obtusa trigona basi angustata, squama minus quam duplo breviore, alba.

Pungo Andongo, rarior ad latera rivulorum umbrosorum prope rupes giganteas de Cabonde ipsius Præsidii, no. 6898. Habitus *Scirpi sylvatici* et affinium.

Its affinity is with *C. simplex* and with the preceding species; but its habit is rather that of *C. albostriatus*. Height of culm 19 inches; leaves more than one foot in length and 5 lines in diameter; the longest involucral bract measures 10 inches. The nut is two thirds of the length of the glume; the lowest glumes in the spikelet are usually more distinctly mucronate than the upper ones.

C. hylæus, n. sp. Viridis, rhizomate repente moniliformiter tuberculoso; culmo singulo

5-pedali acute triquetro striolato; foliis linearibus acuminatis marginibus scabris viridissimis erectis latis, vaginis membranaceis fissis purpureis; panicula maxima diffusa; ramis valde inæqualibus triquetris scabris; involucralibus 8 longissimis latis; spiculis copiosis in apicibus ramorum congestis, minimis paucifloris; squamis ovato-lanceolatis pallide sanguineis mucronatis, mucrone recurvo, carina viridi; stylo caryopsin subæquante profundissime trifido rufo; staminibus 3, filamentis rufis; caryopsi ovata trigona basi angustata rufescente nitida, squama dimidio breviore.

Golungo Alto, ad rivulos in umbrosis de Matta Quisuculo, at non frequens, Jun. Aug. Sep. 1855, no. 6843. "Faca de Dens" indigenarum.

The tubers are used in medicine by the natives.

A large plant with the habit of *Scirpus sylvaticus*, L.; with very long leaves, an inch across, and as much as 21 inches in length. The panicle is large and diffuse, the spikelets very small, about 1 line long; the style is cleft for two thirds of its length. It is most nearly allied to *C. elegans.*

C. ELEGANS, L. Sp. Pl. p. 45.

Pungo Andongo, rarior in umbrosis sylvaticis ad Pungo, ad finem Mart. 1857, no. 6942: in insula Calemba ad flumen Cuanza at unico loco a me observatus, no. 6943: in pratis paludosis inter Condo et Quisonde ad dextram fluminis Cuanza, Mart. 1857, no. 6943 *b*; in paludosis ad rivum Miexe, prope Calundo, Jan. 1857, no. 6944.

Golungo Alto, ad margines rivulorum in montibus de Alta Queta, at non frequens, no. 7071.

Widely distributed over the tropics of both hemispheres. The specimens vary a good deal in size of panicle and colour of the spikelets, which are often of a cinnamon-brown colour.

C. MARITIMUS, Poiret, Encycl. vii. p. 240.

Ambriz, in collinis sabulosis juxta oceanum prope Punta d'Ambriz, no. 7039.

Loanda, in sabulosis supra Loanda (Alto das Cruzes) cum Commelina, no. 7050; frequentissime in omnibus fere arenosis siccis maritimis, Ilha (insula) de Loanda, no. 7044.

Of this plant Dr. Welwitsch says, "Rhizomate crasso intus sanguineo, oblique descendente submoniliformiter articulato. Culmi 1–3-pedales."

It occurs also in the Cape Verd Isles, Madagascar, and the east coast of Africa.

C. FLABELLIFORMIS, Rottb. Gram. 42.

Mossamedes, in lacubus ad ostia fluminis Giraûl, Jul. 18, 1859, no. 6882.

Golungo Alto, frequens ad rivulos omnes e montibus de Mongôlo usque ad Cangueransange, prata palustria omnia quasi palmis pygmæis obtegens, no. 7103.

"This is one of the plants the stalks of which are used by the negroes for wickerwork." It is a native also of Nubia, Congo, Abyssinia, and, according to O. Boeckeler, of Costa Rica.

C. MARGINATUS, Thunb. Prod. p. 18.

Benguella, prope ripas fluminis Bero et in maritimis prope Benguella, Jun. et Jul. 1859; in arenosis ad austrum urbis Benguella, no. 6859.

"Herba perennis halophila, modo crescendi a reliquis hujus generis discrepans."

The old leaf-sheaths at the base of the stem break up by decay, leaving only the black wiry fibro-vascular bundles in a tuft. The culms are more than three feet in height.

This plant occurs also in South Africa.

C. HASPAN, L. Sp. Pl. p. 45.

Congo Ambriz, in sylvestribus uliginosis cum *Flagellaria indica*, prope vicum Ambriz, no. 7035, 7035^{b}.

Bengo, in spongiosis ad fontem ferro oxygenato saturatum, prope Bengo, no. 7086.

Pungo Andongo, Candumba, ad flumen Cuanza, no. 6982; in pratis humidis prope Muta Lucala, at rarius, no. 6982; ad paludes sylvaticas profundiores Præsidii; Lombe, 6908.

This plant is widely distributed over the tropics of both hemispheres.

C. FLAVIDUS, Retz. Obs. v. p. 13.

Loanda, in argillaceis stagnorum exsiccatorum agri Loandensis, prope Forte de Conçeiao, sparsim, Julio 12, 1854, no 7077. Prostratus cæspitosus culmis filiformis debilibus.

Pungo Andongo, in pratis sylvaticis humidis inter Condo et Quisonde ad dextram fluminis Cuanza, Martio 1857, no. 6924; Lagoa de Quibinda, 6920; in stagnis prope Quisonde, no. 6917.

It occurs also in Senegal (Adanson, Heudelot) and in India, the Mascarene Islands, and Tropical Australasia.

C. SABULICOLUS, sp. n. Cæspitosus, radicibus longis tenacibus lanatis; culmis rigidis obtuse triquetris canaliculatis vix pedalibus, basi foliis vetustis latis tecta; foliis linearibus culmo brevioribus glaucis rigidis 4-uncialibus; involucralibus sæpius 3-linearibus, basi parum dilatatis; umbella plerumque compacta; ocreis brevibus truncatis brunneis, breviter laminiferis; spiculis pluribus aggregatis linearibus multifloris; squamis ovatis obtusis brevissime mucronatis, lateribus atrosanguineis, trinerviis, carina viridi, mucrone recurvo; rhacheola angusta recta exalata, foveolis angustis oblongis; stylo trifido gracili rufo haud exserto; caryopsi angusta oblonga in foveola ferme celata, trigona alba.

Barra do Bengo, in collinis sabulosis prope Cacuaco, Dec. 1858, no. 7049.

Congo, Ambriz, in sabulosis collinis maritimis prope vicum Ambriz, Nov. 1853, no. 7038.

Huilla, in collinis siccis inter Lopollo et Eme, ad finem Aprilis 1860, no. 6866.

Pungo Andongo, in paludosis Præsidii, no. 6794.

This plant forms large masses among the sandhills of the coast and inland; its roots are stout and woolly, as is common among sand-loving plants; the lower part of the stem is covered by the remains of the old leaves, which are unusually broad and polished; the culms are from 5 inches to a foot high, the leaves much less, and very numerous.

C. DIFFORMIS, L. Amœn. Acad. iv. p. 802.

Mossamedes, in graminosis æstate inundatis juxta ripas fluminis Bero, prope Caballeiros, sed parcius hoc loco obvius, Aug. 1859, no. 6883, no. 6853. Dande, late cæspitosus, 1–1½-pedalis, ad ripas lacus prope Bombe vicinitate riparum fluminis Dande, Sep. 1848, no. 7027.

Loanda, in fundo argillaceo stagnorum exsiccatorum prope Forte de Conçeiao, at valde rarus, Jul. 12, 1854, no. 7065.

Pungo Andongo, in stagnis sylvaticis inter Condo et Quisonde et Ilhas de Calemba, Mart. 1857, no. 6933; Luxillo, April. 1857, no. 6934.

Golungo Alto, in insulis spongiosis rivuli prope Banza de Bango, sed rara avis, April. 30, Maio 1, 1856, no. 7067.

Ambaca, ad lacum Canguela-Canganga et ad ripas rivi Caringa, Jun. 1855, no. 7066.

Although this plant occurred in nearly all the districts visited by Dr. Welwitsch, it seems to be by no means a common plant. It is widely distributed over the warm regions of the Old World.

No. 6853, from the sandy banks of the river Bero, in Mossamedes, is a very dwarf form, only 2 inches high; possibly it bears the same relation to the normal form that *C. microlepis*, Bak., bears to *C. Iria*, L. (C. B. Clarke, in Journ. Linn. Soc. xx. p. 291); that is, that the plant was developed from a seed which germinates late in the season shortly before the approach of winter. It was collected in July.

C. DICHROOSTACHYUS, Hochst. Herb. Abyss. no. 391. *C. andschoa*, Rich. Tent. Abyss. ii. 481. *C. scirpoides*, R. Br., Salt, Itiner. lxiii.

Huilla ad stagna sylvatica juxta ripas rivi Mupanda, no. 6864.

Has also been collected in Abyssinia by Salt and Schimper, and in Niam-Niam by Schweinfurth, and Madagascar by Hilldebrandt.

C. LEUCOCEPHALA, Retz. Obs. 5, 11.

Pungo Andongo, ad paludes pluviales in locis petrosis inter Præsidium et Quilanga, Feb. 1857, no. 6772.

Huilla, in spongiosis editis montosis Humpata cum Ericaceis, Sobata de Oiahoia Aprili 1860, no. 6783; sparsim in pratis paludosis juxta ripas fluminis Cacalovar; pauca specimina cum floribus, Feb. 1860, no. 1675.

"Capitula nivea, flores diandri; folia ad oras spinuloso-ciliata."

A native also of India, Malaya, and Australia.

C. ELEUSINOIDES, Kunth, En. ii. 39. *C. xanthopus*, Steud. Syn. Glum., ii. p. 86.

Pungo Andongo, gregarius, at non multis locis, ad ripas rivulorum prope Quilanga, et a Nigritis ad "Esteiras" (mats) fabricandas adhibitus, Feb. 1857. "Ntóle," "Iintole" indigenarum, no. 6941.

A large diffuse form, 6 to 8 feet high, with the branches of the panicle 1 to 2 feet long. It occurs also in Abyssinia, Gallabat, India, Ceylon, and Malaya.

C. LÆTUS, Presl, Rel. Hænk. i. p. 170. *C. oostachyus*, Nees, Cyp. Bras. p. 39.

Huilla, in uliginosis sylvaticis nunc fere exsiccatis prope Eme, versus lacum Ivantala, initio Maii 1860, no. 6860.

This species occurs in South America, especially in South Brazil and Chili, and a variety of it in Texas. The Angolan plant differs from the typical form in being more glaucous, and in its rigid leaves with revolute margins; the glumes are rufescent, the roots and vaginæ of the lower leaves red.

C. LATIFOLIUS, Poir. Encycl. vii. p. 268.

Cazengo, ad lacum de Moembege, socialis cum *Cypero papyro*, et Filicibus, at non frequens, Jun. 1855, no. 7068.

Occurs also in the Mascarene Islands, Mozambique, and South Africa.

C. DISTANS, Linn. f. Suppl. p. 103.

Prince's Island, in arenosis ad littus oceani, prope Port de S. Antonio, Sept. 1853, no. 7033 *b*.

Loanda, ad Represa de Quicuxe, no. 7054; Represa de Luiz Gomes, post Alto das Cruzes, Dec. & Febr. 1853–54, no. 7048; in palustribus ad Represas pequeñas do Signor Ricardo, no. 7047.

Pungo Andongo, in pratis paludosis prope Lombe, in ditione Condo, Mart. 1857, no. 6935.

Ambaca, ad lacum Canguele-Canganga, Jan. 1855, no. 7095.

Huilla, in arvis humidis inter *Sorghi* satus, prope Monino, Feb. 1860; flores juniores, no. 6880.

Widely distributed throughout the tropics.

C. LONGUS, L. Sp. Pl. p. 45.

In humidis ad oras plantationum *Sacchari* frequens, Julio 1859, no. 6886.

Distributed all over Africa, as well as Europe, Asia Minor, India, and Malaya.

C. ROTUNDUS, L., var. ELONGATUS, Boeckeler.

Loanda, ad lacum de Quicuxe, Aprili 1854; in paludosis ad flumen Bengo prope San Antonio, frequens, no. 7023, Dec. 1853.

Golungo Alto, frequens circa nigritarum pagos et juxta vias, Sange, April. 1855, no. 7102.

"This species and another besides with yellowish spikelets without tubers * form twice a year (after the rainy seasons) green grass-plots. It infests the fields, and where it once appears is almost impossible to eradicate."

A common tropical weed.

C. ESCULENTUS, L. Sp. Pl. p. 45.

Pungo Andongo, prope Præsidium et Sansamanda, no. 6907.

Golungo Alto, in glareosis ad pedem Montis Cungulungulo, at sparsim, ad finem Jan.

* Probably *C. esculentus*, L., is alluded to.

1855, no. 7098; frequentissimus in herbidis pascuis totius Sobati Bumba post pluvios et circa Sange ubique, Oct. ad Dec. 1855, no. 7102.

An almost cosmopolitan plant.

C. LUCIDULUS, Klein, Lk. Jahrbuch 3, 86. *C. tenuiculmis*, Boeckeler. l. c. 282.

Pungo Andongo, frequens in dumetis inter flumen Cuanza et Caghuy, Jan. 15, 1857; Quitage ad flumen Cuije, no. 6940.

"Planta 3- raro 4-pedalis, radice bulboso-tuberoso aromatico, *Acorum Calamum* mentiente, spicis pendulis."

Occurs also in Gambia, India, and Malaya.

C. SPHACELATUS, Rottb. Gram. 26.

Sierra Leone, juxta rivulum in ipsa urbe Freetown, non procul ab oceano, fere aqua maris humectatus, no. 7056; legi cum aliis Cyperaceis leucocephalis in pratis amœnissime viridibus, jove pluvio, Sept. 1853, inter Freetown et montes vicinos, no. 7058.

Golungo Alto, in arenosis inundatis ad pedem Montis Cungulungula, rarus, Jan. 1855, no. 7070. Loanda (no locality), no. 7102.

Occurs also in the West Indies and South America.

C. HUILLENSIS, n. sp. Late cæspitosus, rhizomate repente lignoso crasso; radicibus elongatis crassis; culmis pedalibus glaucis triquetris striatis, basi subbulbosis; foliis rigidis linearibus subacutis marginibus scabris, culmo brevioribus, glaucis, vaginis fissis; umbella decomposita; foliis involucralibus 2 et ultra- linearibus acutis, umbellam superantibus; ocreis longiusculis truncatis; spiculis aggregatis in apicibus ramulorum, linearibus lanceolatis multifloris; squamis obtusis oblongo-ovatis, carinatis, dorso viridescente, lateribus sanguineis; stylo trifido longiusculo, exserto, brunnescente; caryopsi (immatura) minuta ovata triquetra alba.

Huilla, in herbidis dumetosis inter Nene et Humpata, Maio 1860, no. 6867; in collinis breviter dumetosis siccioribus prope Humpata, nos. 6868, 6869.

Var. APHYLLUS. Culmis dense seriatis erectis; vaginis omnibus aphyllis lanceolatis, inferioribus purpureis; foliis involucralibus 2 erectis, umbella brevioribus; spiculis numerosis linearibus.

Huilla, prope Bumbo, ad rivulum, Jun. 1860, no. 6889.

This species is closely allied to *C. tristis*, Kunth, but differs in the habit and appressed muticous glumes. The culms are 4 inches to 1 foot in height, rising from a tuft of brown membranaceous leaf-bases, with a few younger stiff glaucous leaves; the spikelets are numerous, and reach the length of $\frac{1}{2}$ inch. The nut was very young, and only $\frac{1}{4}$ of the scale in length. The variety *aphyllus* seems to bear the same relation to the leafy form that *C. denudatus*, Vahl, does to *C. sphærospermus*, Schrad. The stem-leaves are reduced to their sheaths, while the involucral leaves, two in number, are short and erect, one of them continuing the culm, so that the umbel appears lateral. The spikelets are rather narrower and darker than in the typical form, and the culms closer together on the woody rhizome.

Some very small and young plants, about 1 inch in height, may perhaps belong to this species; they are labelled "Huilla, in campestribus olim *Solano tuberoso* satis, nunc neglectis, sparsim, rhizomate tuberifero, initio Maii 1860, no. 6865." They seem to have sprung from bulbils, and, though none of the other specimens are bulbilliferous, as they seem in all other respects except size to be identical with this plant, I am inclined to refer them to it.

C. ACTINOSTACHYS, Welw. MSS. Cæspitosus, glaucus, radicibus copiosis, tenuibus; culmis erectis crassiusculis ultra pedalibus striatis obtuse triquetris; foliis linearibus rigidis recurvis culmo multo brevioribus, vaginis longiusculis truncatis sæpius fissis purpurascentibus striolatis; involucralibus circa 6, linearibus longis recurvis basi dilatatis; umbella simplici, radiis valde inæqualibus patentibus; ocreis brevibus truncatis purpureis; spiculis pluribus congestis patentibus linearibus multifloris; squamis lanceolatis breviter mucronatis remotiusculis trinerviis, carina viridi lateribus atropurpureis, costulis pallidis; stylo gracili trifido parum exserto, rufescente; caryopsi oblonga obtusa trigona atra.

Huilla, in sylvis mixtis claris, Monino, ad finem Martii, no. 6874; in arena calida ad ripas fluminis Cuanza prope Candumba, Jan. 30, 1857, no. 6928, no. 6931.

The spikelets are aggregated in capitula at the extremities of the rays of the umbel, radiating from the centre as in *C. dilutus*, Vahl, whence the specific name. The involucral leaves are about 8 inches in length, and usually purple at the base.

C. ANDONGENSIS, n. sp. Glaucus, radicibus copiosis fibrosis; culmis obtuse triquetris ultra pedalibus gracilibus erectis rigidis striatis; foliis pluribus angustissime linearibus semipedalibus, marginibus scabridis, vaginis membranaceis brunneis fissis; involucralibus 3–4 angustis linearibus patentibus, basi vix dilatatis; umbella compacta, radiis sæpius brevissimis; rhacheola subflexuosa angusta, foveolis angustis oblongis; spiculis pluribus linearibus; squamis remotiusculis atrosanguineis trinerviis oblongolanceolatis obtusis brevissime mucronatis lucidis; stylo profunde trifido, caryopsin subæquante vix exserto, rufo; caryopsi oblonga, basi angustata breviter apiculata, nigra punctata, squama duplo breviore.

Pungo Andongo, in arena calida ad ripas fluminis Cuanza, prope Sansamanda, Feb. 1857, no. 6929.

Culms erect and stiff, but slender, $1\frac{1}{2}$ foot high; leaves narrow, stiff, and wiry, almost setaceous, with broader polished brown bases; the spikelets unusually long and narrow.

C. BULBOSUS, Vahl, Enum. ii. *C. laxus*, R. Br., Salt. It. Abyss. p. 2, xiii.

Mossamedes, in cultis neglectis prope Cavalheiros, frequens et late cæspitosus, Aug. 1859, no 6852.

Loanda, in arenosis juxta oceanum atlanticum, prope ostia fluminis Cuanza, Maio 1854, no. 7073; in maritimis ad Samba Grande et Cabo Lombo, April. 1854, no. 7074.

Occurs also in Abyssinia, Arabia, the Cape Verd Islands, Senegal, and India.

C. APRICUS, n. sp. Cæspitosus, radicibus fibrosis crebris; culmis gracilibus triquetris basi bulbosis semipedalibus striatis; foliis pluribus angustissime linearibus, culmos subæquantibus; involucralibus 2 gracilibus demum recurvis apice scabris, biuncialibus, basi parum dilatatis; spiculis lineari-lanceolatis semiuncialibus multifloris, patentibus; squamis ovatis lanceolatis obtusis mucronatis, mucrone parum recurvo, 5-nerviis, atrosanguineis; filamentis elongatis complanatis; stylo breviter trifido parum exserto; caryopsi acinaciformi haud trigona, atropurpurea punctata; rhacheola recta exalata, foveolis angustis oblongis.

Pungo Andongo, in apricis Præsidii rupestribus cum *Actinopteride flabellata,* Dec. 1856; inter Muta Lucala et Quibinda, Mart. 1857, no. 6915; nos. 7163, 7154, no special locality.

The affinity of this plant is with *C. bulbosus,* Vahl, from which the habit, the absence of the bulbil, the narrow leaves, the longer mucro of the glume, and the shape of the fruit readily distinguish it. The plants grow closely together, forming a tuft; about five spikelets are loosely aggregated at the summit of the culm.

C. ATRACTOCARPUS, n. sp.; radicibus pluribus sublanatis; culmis basi bulbosis, gracilibus glaucis subpedalibus striatis teretiusculis; foliis copiosis angustissime linearibus acutis glaucis, culmis multo brevioribus, vaginis striatis brunneis basi reticulatis; involucralibus 1–2 sæpius spiculis brevioribus angustissime linearibus striatis basi parum dilatatis; spiculis 1–3 erectis linearibus uncialibus, 12-floris et ultra; squamis linearibus lanceolatis angustis multistriolatis laxiusculis sanguineis, carina viridi; stylo longissimo trilineali, profunde trifido basi flexuoso pallido; caryopsi fusiformi subcylindrica, albescente bilineali.

Huilla, in pascuis editioribus Empalanca, frequens, Febr. et Apr. 1850, no. 6863.

The few long, slender, erect spikelets, the very long deeply-cleft style, the nearly cylindrical caryopsis tapering at both ends, distinguish this plant from its allies. It has some affinity with *C. rupestris,* Kunth, but the spikelets are not flattened. The culms about 8 inches high, the leaves 2 inches in length.

C. ARTICULATUS, L. Sp. Pl. p. 44.

Congo, ad margines lacuum Quisembo, Nov. 1853. Icolo e Bengo, Lagoa de Funda, prope Funda, no. 7051. Pungo Andongo, gregarie ad ripas paludosas fluminis Cuança prope Sansamanda et prope Mopopo cum *Phœnice spinosa,* Feb. 6, 1857, no. 6936.

Forma haud articulata, in dumetosis palustribus ad ripas fluminis Lombe, prope Lombe, no. 6937. "Culmorum articulos in hac specie numquam observavi."

The base of the culms are hard as wood and tuberous; the tubers have a pleasant aromatic smell, and are used frequently by the natives for intestinal pains.

In Ashantee, according to Dr. Bowdich, it is administered as an antihelmintic.

The plant is widely distributed over the tropics of both hemispheres.

C. PAPYRUS, L. Syst. Veg. 99.

"Est Cyperacearum princeps, totius familiæ stirps maxima et formosissima, necnon incolarum economica utilissima, chartam, tecta, strabula, lecticas, immo pontes etc. indigenis præbere potest." Loanda, ad margines rivi Delamboa, socialis cum *Caladio, Costo, Raphia,* etc. Maio 1855, no. 7104; ad stagna Maghellas prope Boa Vista, sparsim, no. 7085.

Common all over Africa, and occurring also in Sicily, Asia Minor, Mauritius.

C. AURICOMUS, Sieber, Herb. Ægypt.

Loanda, Boa Vista, ad stagna artificialia, no. 7043; plus quam 3 metra altus.

Dande, frequentissima circa lacus ad ripas fluminis Dande, Sept. 1858, 3–5-, imo 7-pedali; prope Bomba, no. 7042.

Huilla, in paludibus sylvaticis apud flumen Mupanda, Feb. 1860, no. 6870.

Barra do Bengo, ad lacum de Quifandongo in paludosis frequens, Dec. 1853, no. 7080. The latter is a form with remarkably narrow involucral leaves.

Egypt; Senegal; Nupe; Natal; Cape; Italy (*Rabenhorst*); India; Malaya; South America.

C. RADIATUS, Vahl, Enum. ii. 369.

Icolo e Bengo, ad ripas lacus prope Fóto, at non frequens, Sept. 1857, no. 7030.

Dande, in uliginosis arenoso-argillaceis circa lacus ad dextram fluminis Dande, prope Bombe, no. 7036.

C. LIGULARIS, L. Sp. Pl. ed. 2, p. 70.

Prince's Island, rarior in subhumidis ad sylvarum margines in ascensu de Pico de Papagaio, Sept. 1853, no. 7037.

Widely distributed in America from Virginia to Brazil; in Africa on the West Coast from Senegambia to the Congo; it also occurs in Madeira, the Cape Verd Isles, Fernando Noronha, and Madagascar.

C. FERAX, A. Rich. Act. Soc. Nat. Hist. Paris, i. p. 106.

Prince's Island, in littore arenoso humido ad Port de S. Antonio, at rarior, Sept. 1853; "spiculæ e viridi flavescentes rarius rubellæ; culmos usque 6-pedales vidi," no. 7033.

Icolo e Bengo, cæspitose in uliginosis unacum *Pistia terrestri,* ad margines, Lagoa de Quibinda, Sept. 5, 1857.

A native also of Senegal, Senegambia, Senaar, and Mozambique, as well as Malaya and South America.

Dr. Welwitsch says of it:—"Spicæ juveniles cylindricæ, adultæ et seminiferæ dilatatæ et difformes; in juventute et florentes virides, in vetustate fusco-brunneæ."

C. DIVES, Del. Egypt, v. t. 4. fig. 3.

Pungo Andongo, inter Quisonde et Condo, in paludosis sylvaticis, no. 6989.

Golungo Alto, frequens ad rivulos Cuango et Quiaposa, prope Sange, Nov. 1854, no. 7091; 4–7-pedalis.

Occurs also in Madagascar, Asia Minor, India, Malaya, and Australia.

C. CALLISTUS, n. sp. Herba ex bulbillo oriens, bulbillo castaneo tunicato ovato acuto radicibus fibrosis tenuibus; culmo singulo 4–5-pedali crassiusculo triquetro canaliculato; foliis viridibus linearibus longe acuminatis strictis culmum subæquantibus margine scabriusculis, vaginis membranaceis fissis; involucralibus 6–8 patentibus demum reflexis longissimis linearibus, longe acuminatis basi vix dilatatis; umbella magna, radiis valde inæqualibus; spiculis linearibus 7- vel 8-floris patentissimis aureofulvis; bractea ad basin sæpius longissima acuminata; ocreis truncatis semiuncialibus; squamis linearibus oblongis obtusis remotiusculis, carinatis multistriatis; stylo brevi pallido breviter trifido; caryopsi lanceolata triquetra atro-sanguinea minute punctata, squama duplo breviore.

Loanda, ad stagna in herbidis prope Quicuxe, parce, Martio 1857, no. 7079.

A remarkable plant of the *Diclidium* section. According to Dr. Welwitsch it attains 4 or 5 feet in height; his specimens, however, are only about 2 feet. The plant springs from a bulbil, like that of *C. bulbosus*, Vahl. The leaves are long and rather flaccid, and the involucrals attain a length of 8 inches. The rays of the large umbel are about 11 in number, the longest measuring 5 inches.

C. EURYSTACHYS, n. sp.; rhizomate descendente; culmis erectis validulis elatis subtriquetris striatis, basi subbulbosis; vaginis subefoliatis fissis striatis purpurascentibus; involucralibus 9-linearibus viridibus complanatis carinatis, pedalibus, basi latis, erectis demum reflexis; radiis umbellæ, circiter 12, valde inæqualibus, alteris longis biuncialibus patentibus, alteris ferme sessilibus; ocreis oblique truncatis ampliatis striatis; spicis ovatis, spiculis copiosis patentibus vix compressis quadrifloris; squamis lanceolatis appressis 10-costatis, dorso viridi, costis pallidis, lateribus pallide sanguineis; stylo longo trifido profunde exserto rufo; caryopsi oblonga trigona leviter arcuata, lateribus excavatis, squama dimidio breviore, rufescente, punctata; rhacheola flexuosa late alata fragili, alis scariosis.

Huilla, in sylvarum mixtarum herbidis humidiusculis, cum *Gladioli* specie, sporadica ad finem Aprilis 1850, no. 7061.

The affinity of this plant is with *C. Meyenianus*, Nees. It is remarkable for the absence of leaves at the base of the culm. The culm is three feet in height; the involucral bracts, very unequal in length, attain a length of 12 inches, and are $\frac{1}{4}$ inch in diameter. The spikelets are rather loosely aggregated into ovate spikes $\frac{3}{4}$ inch in length, the inferior ones on peduncles $1\frac{1}{2}$ inch long. They consist of four perfect flowers, and are $3\frac{1}{2}$ lines in length. The ocreæ are 2 lines long. The glumes are 10-ribbed, the keel green, and the space between the ribs pale red.

C. TANYPHYLLUS, n. sp. (τανύφυλλος=longifolius.) Cæspitosns, rhizomate brevissimo vix repente; culmis 1–2-pedalibus, triquetris canaliculatis, basi subbulbosis; foliis linearibus flaccidis culmo brevioribus; vaginis integris chartaceis brunneis; involucralibus 5–7 longissimis viridibus flaccidis linearibus basi haud dilatatis, marginibus et costis scabris; umbella 5–11-radiata, radiis pollicaribus striatis; spiculis remotiusculis patentibus lanceolatis acuminatis subteretibus 4-floris; squamis ovatis breviter mucronatis 9-costatis; dorso viridi, lateribus fulvis; rhacheola flexuosa alata, alis scariosis; caryopsi obovata basi angustata, acute triquetra rugoso-punctata atra, squama duplo breviore.

Golungo Alto, in sylvis primævis Sobati Quilombo Quiacatubia, nos. 7010, 7171 *b*; Quibanga 7006 *b*; prope Sange, Dec. 1854, no. 7010.

A rather flaccid plant, with an umbel of rather long rays nearly 2 inches in length. The spikelets, somewhat distant, are $\frac{1}{4}$ inch in length. The involucral leaves are unusually long, attaining a length of 9 inches. The nut is broadly ovate, with acute angles, unlike that of any of its congeners.

C. UMBELLATUS, Benth. Fl. Hongk. p. 386. *Mariscus Sieberianus,* Nees, Sieb. Fl. Maurit. no. 3.

Prince's Island, Porto San Antonio, frequens in sylvestribus subsiccis regionum inferiorum, Sept. 1853, no. 7064, 7068.

Sierra Leone, in montosis sylvestribus supra Freetown, no. 7062.

Loanda, no. 7012, 7006. Golungo Alto, in sylvis primævis de Quibanga, Dec. 1855, no. 7006.

Pungo Andongo, in umbrosis ad Cataractam Calundo ipsius Præsidii, Nov. 1856, no. 7009. Herba tota flavo-viridis, nitens rigida.

Var. CYLINDROSTACHYS, C. B. Clarke, Linn. xx. 296, no. 7008, 7165. No specific localities.

Distributed over the tropics of both hemispheres.

C. FLAVUS, Boeckeler, Linnæa xxxvi. 284. *Mariscus flavus,* Vahl, Enum. ii. 374. *M. aggregatus*, Willd. Hort.

Pungo Andongo, Condo Quisonde, Martio 1857; insula Calemba, ad Cuanza; Candumba, no. 7009.

This is the compact-headed form, with 8-flowered spikelets, formerly cultivated under the name of *M. aggregatus,* Willd. The plant occurs abundantly in the West Indies, the southern United States, and South America.

C. MYRMECIAS. n. sp. Cæspitosus, rhizomate descendente; culmis subpedalibus crassiusculis triquetris striatis; foliis copiosis late linearibus acuminatis carinatis scabridis, basi purpurascentibus erectis; involucralibus 7 et ultra, erectis demum patentibus, late linearibus acuminatis, semipedalibus; radiis umbellæ 9–10, longis valde inæqualibus; spicis oblongo-ovatis; bracteis sæpius duabus anguste linearibus infra infimas spiculas; spiculis copiosis laxe aggregatis, in rhachidi angulata impositis, linearibus acutis trifloris; squamis oblanceolatis 6-costatis, dorso viridi, lateribus flavescentibus; stylo breviter trifido parum exserto, pallido; caryopsi (immatura) lanceolata, trigona, basi angustata flavescente.

Huilla, late cæspitosus in pratis sylvaticis inter Lopollo et Monino frequens, ad elevationes arenosas compactas formicarum. Mart.–Maio 1860, no. 7059, in herbidis sylvarum clariorum Monino vix cæspitosus, no. 7060.

A rather compact plant, with broadly linear acuminate leaves, 6 inches long; culms about 10 inches in height; involucral bracts long and spreading; spikes half an inch long, on peduncles of varying length, the longest $1\frac{1}{2}$ inch; spikelets numerous, crowded together but not compactly, the rhachis being angled and not cylindrical as in most Marisci. The ocreæ are rather long and obliquely truncate. It is related to *C. flavus*, Boeckeler.

KYLLINGA CÆSPITOSA, Nees, Cyp. Bras. p. 12.

Pungo Andongo, frequens in rupium pascuis breviter graminosis humidis editioribus cum *Cleome*, sp., prope rupem Cabonde, 7153, 7158; in humidis pratis sylvaticis inter Bumba et Conde, frequens ast non evoluta, Mart. 1857, no. 6798; in udis spongiosis rupium editiorum cum *Drimia*, *Melanthio* etc. Nov. 1856, no. 7160; (also nos. 7005, 7176, 6790; no localities.)

Golungo Alto, in declivibus ad Queta orientem juxta rivi ripas, Dec. 1855, no. 7012*a*.

Var. ANGUSTIFOLIA; rhizomate brevi; culmis 3–4-uncialibus setaceis; foliis angustissimis gracilibus, $2\frac{1}{2}$–2-uncialibus; involucralibus 3, uno erecto; capitulo singulo minimo paucifloro. Pungo Andongo, no. 6781.

The typical form of *K. cæspitosa*, Nees, has no creeping rhizome, but several of these plants have a short stout rhizome covered with the remains of the leaves of the previous years. The variety *angustifolia* is distinguished by its narrow leaves and very small single capitulum; the lowest involucral leaf is 1 inch long and erect, so that it appears to continue the stem.

The species is abundant in North and South America, but does not seem to have been hitherto recorded from the Old World, except in the form of the variety *robusta*, Boeckeler, a native of the Philippines. Dr. Welwitsch adds the following note:—"Culmi juniores erecti, fructiferi nutantes vel decumbentes."

K. TRICEPS, Rottb., Descr. et. Ic. p. 4, t. 4, f. 6.

Loanda, in breviter graminosis inter Penedo et Conçeiao, no. 6999 *b*; frequens in pascuis breviter herbidis inter Loanda et Penedo, non procul ab oceano, no. 6995; in humidiusculis littoralibus de Samba Grande, cæspitosa ast rarius obvia, est ex Cyperaceis elegantissima, no. 6793.

Benguella, frequens, sed unico loco visa in humidiusculis breviter herbidis ad austrum urbis Benguella, juxta margines stagni nunc fere sicci. Init. Jun. 1859, no. 6792.

Pungo Andongo, Catete, cum *Polygala microdendron*; et in spongiosis paludosis rupium editiorum versus austrum Præsidii, no. 6791, ad paludes pluviales locis spongiosis inter Præsidium et Quilanga, Feb. 1857, no. 6780, in uliginosis ad Mutollo, ad finem Feb. 1857, no. 6787.

Var. OBTUSIFLORA, Boeck., Cyp. Berl. Herb. p. 18.

Pungo Andongo, in pascuis humidis rupestribus ad rivum Casalale, no. 6789.

Huilla, in uliginosis decliviis juxta rivulos in Morro de Lopollo, versus Empalanca. jam fere defloratus, medio Maii 1860, no. 6795.

Var. LONGISPICATA. Capitulo intermedio elongato, cylindrico semiunciali, capitulis lateralibus duobus parvis, rarius nullis; squamis sæpe purpureo-punctatis, foliis latioribus.

Sierra Leone, frequens in herbidis prope Freetown, no. 6989.

Also collected in Madagascar by Hilsenberg and Bojer, in Herb. Brit. Mus.

This variety has very much the habit and general appearance of *K. cylindrica*, Nees, but the spikelets are flattened and not swollen as in that species. The leaves are 2 lines in diameter, somewhat broader than those of the typical form.

The plant is a native also of India and Malaya, but seems to be most abundant in Africa. The flowering-season in West Africa seems to be February and March, as the specimens gathered in December were in bud, and those in May almost past flower.

K. CYLINDRICA, Nees, Wight. Bot. 91.

Golungo Alto, in decliviis humidiusculis et palmetis, Montes de Queta, Nov. 1855, no. 7005.

Occurs also in India.

K. OBTUSATA, Presl, Rel. Hænk. i. 183.

Pungo Andongo, in uliginosis sæpe inundatis in insulis dictis de Calemba, in flumine Cuanza prope Condo, Martio 1857.

Hitherto only recorded from the West Indies and Tropical South America.

K. AROMATICA, n. sp. Late cæspitosa, rhizomate repente tenacissimo lignoso, radicibus crassiusculis; culmis approximatis erectis rigidulis, strictiusculis 2–3-pedalibus triquetris canaliculatis crassiusculis glabris; foliis linearibus acutis, culmis dimidio brevioribus, margine scabridis; vaginis longis, ore truncatis brunneis chartaceis purpureo-punctatis; involucralibus 2 erectis, demum patentibus linearibus margine scabriusculis; capitulo singulo viridescente; spiculis plurimis conferte aggregatis elongatis angustis fere lanceolatis bifloris; squamis acuminatis, acumine recurvo, dorso ciliatis, inferiore mascula, 8-nervia, superiore 4-nervia; stylo breviter bifido rufo; caryopsi oblonga breviter apiculata lenticulari atropunctata.

Pungo Andongo, in rupium fissuris ad rivulum Malemba, prope Candumba, socialis cum *Bambusa*, Mart. 1857, no. 6801; in ipsis fluminis Cuanza aquis, Feb. 28, 1857. Capitula viridescentia; rhizoma grate aromaticum fere *Acori Calami*.

The affinity of this plant is with *K. melanosperma*, Nees, from which it may be distinguished by its more numerous and longer leaves, larger number of involucral leaves, and neuration of the glumes. The leaves are about 1 line in diameter, the involucral leaves very long, attaining a length of 6 inches.

K. AURATA, Nees, Linn. vii. p. 512.

Pungo Andongo, in spongiosis paludosis rupium editiorum versus austrum Præsidii; in dumetosis subarenosis humidis prope Luxillo, no. 6808; circa Lagoa de Quibinda, Mart. 1857, no. 6800 pars.

Loanda, frequens circa stagna prope Represa de Luiz Gomez, Jan. 1858, no. 6999, 6797. Dande, ad lacum Bombo, Aug. 1858, no. 6799.

Huilla, in pascuis macris breviter dumetosis prope Lopollo, Feb. et init. April. 1860, no. 6809, in pratis sylvaticis ad flumen Cacolovar, frequens, no. 6810.

This plant varies very much in habit. The most striking forms are no. 6800, a strict erect plant, almost leafless, with a rather thick rhizome and very patent involucral leaves, which give it much the appearance of *K. obtusata*, Presl, and no. 6808, a very slender form, with long and narrow leaves, small capitula, and reflexed involucral leaves. The species is abundant also in Madagascar, and a variety occurs in the Neilgherries.

K. MONOCEPHALA, Rottb. *l. c.* p. 13.

Prince's Island, in subsiccis sylvestribus editioribus, Sept. 1853, no. 6988.

Widely distributed in the tropics of the Old World.

K. ALBA, Nees, Linn. x. 140.

Huilla, in pascuis breviter herbidis siccioribus ad Empalanca, versus finem Martii 1860, no. 6805; Catumba, no. 6812; in pascuis editis tempore pluvio inundatis Morro de Monino, April. 1860, no. 6806. Capitula albo-virescentia, rhizomata strenue aromatica.

Occurs also in South Africa.

K. SQUAMULATA, Vahl, Enum. ii. 381.

Sierra Leone, in graminosis inter Freetown et Sugarloaf Mountain, Sept. 1853, no. 6987.

Is found also in Abyssinia.

K. WELWITSCHII, n. sp. Viridis, rhizomate brevi; culmis glabris subpedalibus, erectis triquetris præsertim versus apicem, canaliculatis; foliis flaccidis anguste linearibus culmo brevioribus; capitulo singulo, ovato, sæpe altero minore laterali; foliis involucralibus 4 linearibus basi dilatatis; spiculis lanceolatis, acutis, dense aggregatis; squamis navicularibus carinatis, carina viridi ciliata, lateribus pallidis purpureo-punctatis; squama inferiore 8-nervata, suprema 4-nervata, mucronata, mucrone recurvo; staminibus exsertis; antheris brunneis; caryopsi ovata oblonga lenticulari brevissime apiculata flavescenti.

Pungo Andongo, ad margines fluminis Cuanza, prope Calemba, Mart. 1857, no. 6779, inter Lombe et Muta Lucala, 1856.

This plant has a close affinity with *K. alata*, Nees, but is entirely glabrous; the leaves are also narrower. The involucral leaves attain a length of 2 inches; the culm is from 4 to 10 inches in height; the caryopsis, which is not quite mature, is $\frac{1}{2}$ line in length.

K. PAUCIFLORA, n. sp. (Plate XXIII. figs. 1–4.) Glaucescens, rhizomate breviter repente, vaginis vetustis tecto, radicibus crebris sublanatis; culmis decumbentibus pedalibus acute triquetris; foliis linearibus acuminatis culmis dimidio brevioribus complanatis carinatis, carina marginibusque apicum scabridis; vaginis integris purpureo-punctatis; involucralibus 3–4, uno erecto biunciali, altero breviore patente, linearibus acuminatis basi haud dilatatis, marginibus carinaque apicum scabridis; spiculis in capitulo perpaucis, triglumibus, basi squama ovata parva munitis; rhachide haud tereti, tenui brevissima subflexuosa; squama inferiore vacua, naviculari carinata mucronata sex-costata aurantiaca, carina viridi sæpius spinulosa; squama superiore hermaphrodita elongata oblongo-ovata mucronata, mucrone recurvo, aurantiaca, carina viridi; staminibus tribus, filamentis elongatis complanatis, antheris oblongis apiculatis; stylo gracili parum exserto profunde bifido rubro; caryopsi (immatura) ovata flavescente; flore supremo masculo; squama oblonga scariosa tenuissima; staminibus tribus.

Huilla, juxta rivulos in paludosis inter Ferrao da Sola et Catumba, Martio, Aprili, 1860, no. 6811.

This plant has somewhat the habit of one of the few-flowered *Marisci*, while the spikelets suggest those of *K. aurata*, Nees. The spikelets are very few in number, and rather longer than those of most species of *Kyllinga*. The lowest glume is empty, and clasps the base of the second, which is longer and more distinctly mucronate, and subtends three stamens and a pistil. This glume also includes the third flower, entirely concealing it from the exterior, so that on opening the glume the third flower appears placed between the reproductive organs and glume of the second flower. The terminal flower consists of 3 stamens and a transparent palea-like glume. At the base of each spikelet is a small ovate scale or bract. The rhachis is not cylindrical as usual, but very slender and short, and somewhat flexuous. This structure is so unlike that of any other *Kyllinga*, that the plant should be placed in a distinct section of the genus. The style is stated by Dr. Welwitsch in his notes to be trifid; but all the flowers that I examined had bifid styles, as have the rest of the genus. It is possible it varies in this respect. In some capitula one of the spikelets has become viviparous, giving rise to a tuft of leaves, the remaining spikelets being abortive.

HELEOCHARIS ANCEPS, n. sp. Laxe cæspitosa; radicibus copiosis fibrosis; culmis compressis ancipitibus, patulis canaliculatis punctatis; vaginis 2, obtuse acuminatis, suprema ampliata pallida, inferiore membranacea; spicula parva ovata lanceolata, bilineali multiflora; squamis ovatis obtusis alte carinatis membranaceis, marginibus scariosis, pallidis sanguineo-punctatis, basi carinæ sanguinea, setis nullis; stylo breviter trifido gracili rufo; caryopsi obovata, obtusa triquetra, flavescente vel alba, tuberculo magno obtuse conico.

Pungo Andongo, in graminosis sylvestribus humidis inter Mopopo et Sansamanda, Maio 1857, no. 7170; in arenosis humidis prope Condo ad ripas sylvestres fluminis Cuanza, Martio 1857, no. 6817.

Allied to *H. albivaginata*, Boeckeler, but differs in the absence of setæ and the shape of the nut. It frequently produces a short descending rhizome; the culms are from 2 to 7 inches in height, and more than $\frac{1}{2}$ line in diameter. There are a considerable number of barren ones. The spikelet is small, the glumes pale, with the sides and base of the carina purple.

H. CHÆTARIA, Rœm. & Schult. Syst. Veg. ii. 154.

Huilla, in pascuis editis ad Morro do Monino, locis breviter herbidis arenosis, tempore pluvio inundatis, aliis glumaceis intertexta, Apr. 1860, no. 6964.

This is a very widely distributed tropical plant. The specimens are small, and 2–3-flowered.

H. PALUSTRIS, R. Br. Prodr. Fl. N. Holl. p. 80.

Huilla, in arenosis humidis ad rivum Lopollo, socialis cum multis aliis Scirpoideis, April. 1860, no. 6969.

An almost cosmopolitan and very variable plant. The style was bifid in the few flowers I examined, but Dr. Welwitsch found it trifid. It is known to vary in the species. There were three linear setæ, and the caryopsis was yellowish brown.

H. PLANTAGINEA, R. Br. l. c.

Ambaca, ad lacum Canguele-Canganga, non procul a Rio Caringa, sat frequens, Jun. 1855, no. 6842.

Huilla, ad stagna sylvatica juxta flumen Cacolovar, prope lacum Ivantala, at nondum bene evoluta, ad finem Februarii 1860, no. 6968.

Occurs also in India, Polynesia, China, Madagascar, and America.

DICHROMENA CANDIDA. *Psilocarya candida*, Nees, Cyp. Bras. p. 117. *Rhynchospora candida*, Boeckeler, Cyp. Herb. Berol. p. 765.

Huilla, in pratis sylvaticis humidiusculis de Monino et versus Catumba, socialis cum *Scabiosa* et variis *Labiatis*, Martio Maio, no. 6840.

Has also occurred in Lagos, W. Africa, Madagascar, and in Brazil. It is remarkable as the only species in the genus occurring out of America.

FIMBRISTYLIS MONOSTACHYA. *Abilgaardia monostachya*, Vahl, Enum. ii. 296.

Huilla, in pratis breviter herbidis arenoso-argillaceis inter Monino et Eme, unico loco frequens; init. April. 1860, no. 6839.

Common in the tropics of both hemispheres.

F. SQUARROSA, Vahl., Enum. ii. p. 283.

Dande, unico loco visa ad ripas lacus majoris prope Bombo, ast hoc loco non frequens, cum floribus ad finem Sept. 1858. Tota planta in vivo læte viridis, ex siccitate demum canescens apparet, no. 6997.

Common in the hotter regions of both hemispheres.

F. FERRUGINEA, Vahl, l. c. 291.

Mossamedes, in lacunis exsiccatis ad ripas fluminis Caroca, at non frequens, Sep. 1859, no. 6970.

Var. GRAMINEA. Culmis gracilibus elongatis; foliis perangustis longissimis gracilibus, spiculis paucis, 2–3, semiuncialibus, pedunculis longis; involucralibus longis foliosis deflexis.

Insula Sancti Jacobi, frequens, Jan. 1861, no. 7105.

A very tall slender form, nearly 3 feet in height. The species occurs in all the hotter parts of the world.

F. COMMUNIS, Kunth, Enum. 235. *F. polymorpha*, Boeckeler, Cyp. Berl. Herb. p. 551.

Sierra Leone, in palmetis humidis ad rivum Cuango, Nov. 1853, no. 7017.

Ambriz, in humidis graminosis ad austrum vici Ambriz, Nov. 1853, no. 7002.

Pungo Andongo, Quitage, apud Cuije, no. 6832, sparsim ad ripas rivulorum prope Quilanga, no. 6830 *d*; ad ripas paludosas fluminis Cuanza, prope Sansamanda, frequens, Feb. 1857, no. 6834; in cultis ad rivulum Miege, prope Caghuy, no. 6835 *b*, Sansamanda, no. 6827, Manghe-candumba, no. 6827; Muta Lucala, 6830 *c*; Lagoa de Quibinda, no. 6823 *b*; in uliginosis, prope Cazellas, Præsidium de Guinga; Umbilla, ad Cuanza, no. 6827.

Golungo Alto, in pascuis ad Quilombo Quiacatubia, Jan. 1855, no. 7019. Ambaca, non infrequens, in spongiosis ad ripam sinistram Rivi Caringa, no. 7018.

An exceedingly polymorphic and widely distributed plant. Boeckeler, l. c., has given to the species the new name of *polymorpha*, citing at the same time some fifty synonyms. The oldest name for any of the forms he includes in the species is *F. laxum*, Vahl, Enum. ii. 292 (1805). Kunth, however, gave the name of *communis* to a number of the forms, and consequently either of these names has priority over that of Boeckeler; as, however, the names *F. laxum*, *serrulatum*, *puberulum*, and *hirtellum*, Vahl, apply rather to forms or varieties than to the whole species, as now understood, perhaps Kunth's name of *communis* would be the most suitable title for it.

F. COMPLANATA, Link, Hort. i. 292.

Pungo Andongo, ad ripas rivulorum prope Luxillo, Feb. 1857, no. 6835.

Huilla, in pascuis dumetosis æstate inundatis macrioribus prope Eme, fin. Mart. 1860, no. 6971.

Common in the tropics of both hemispheres.

F. RIGIDULA, Kunth, l. c. 231. *F. glomerata*, Nees, Cyp. Bras. 77.

Loanda, rarior, uno loco visa in arenosis maritimis Sesuvio-Portulacastro obductis ad Praia da Zamba grande, ad S. W. Loandæ, cum floribus et fructibus, Jan. 16, 1859, no. 6993.

Apparently a common and widely spread tropical sea-shore plant. Dr. Welwitsch says of it, "late denseque cæspitosa, fibrillis tenacissimis longis subsimplicibus in Portulacetis (proprius in Sesuvietis) maritimis fixa, culmis basi foliosis, cæspites *Armeriarum* fingentibus.

FIMBRISTYLIS (§ ONCOSTYLIS) MACRA, n. sp. Glaucescens, rhizomate breviter repente; culmis basi bulboso-incrassatis erectis approximatis gracilibus subpedalibus obscure tetraquetris striatis, glabris; foliis culmo multo brevioribus, setaceis, glabris scabris cancellatis; vaginis ferrugineis membranaceis, ore ciliatis; spicula singula raro altera, lanceolata acuta; involucralibus duobus setaceis erectis vel parum recurvis, uno spiculum subæquante, vel longiore; squamis lanceolatis acutis carinatis glabris ferrugineis, carina pallidiore; stylo trifido rufo parum exserto; caryopsi obovata obtuse trigona transversim rugosa, squama dimidio breviore, alba, bulbo parvo.

Huilla, in pascuis macrioribus dumetosis agri Lopollo, non frequens, Feb. 1860, no. 6955.

The affinity of this plant is with *F. festucoides*, Poir. It is remarkable for the usually solitary spikelet. The culms are about 9 inches in length, the leaves 3 inches.

F. APHYLLANTHOIDES, Welw. MS.; rhizomate descendente crasso; radicibus validulis; culmis paucis rigidis erectis bipedalibus obtuse triquetris; foliis linearibus obtusiusculis rigidis glaucis, culmo dimidio brevioribus; vaginis membranaceis fissis basi castaneis lucidis, marginibus supra ciliis albis rigidis munitis; involucralibus duobus mox deciduis brevibus linearibus obtusis basi dilatatis, margine lato membranaceo; capitulo singulo magno compacto; spiculis 6–8 oblongis magnis aggregatis; squamis linearibus oblongis acutiusculis carinatis punctatis fulvo-brunneis margine scariosis; staminibus tribus, antheris linearibus obtusis rubris; stylo longo trifido exserto rubescente, basi dilatato; caryopsi minima alba rugosa, oblonga trigona, tuberculo magno rufo.

Pungo Andongo, in collinis apricis sylvestribus prope Condo, ad dextram fluminis Cuanza, et Quisonde, Mart. 1857, no. 6837; *staticem* fingit.

The affinity of this plant appears to be with *F. schœnoides*. It has the habit of a *Schœnus*, with stiff culms 2–2½ feet in height, a single large capitulum ¾ inch long, and deciduous involucral bracts, the longest of which is barely an inch in length. The glumes are ½ inch in length and usually yellowish brown, but often with a darker sanguineous patch on each side of the carina. There are about 20 flowers in the spikelet.

F. KUNTHIANA, *Isolepis schœnoides*, Kunth, l. c. 208. *Scirpus schœnoides*, Boeckeler, l. c. 514.

Huilla, in collinis decompositis schisti arenacei, lecta prope Nene, Nov. 1859, no. 6949.

A native also of the Cape and Madagascar. It is necessary to change the name of this plant in transferring it to the genus *Fimbristylis*, as the specific name *schœnoides* is preoccupied. The Mascarene plant differs somewhat in pilosity from the African plant, and was described by me under the name *F. schœnoides*, var. *ciliata*, Journ. Linn. Soc. xx. It will be necessary to alter the name to *F. Kunthiana*, var. *ciliata*.

F. MELANOCEPHALA, n. sp. Humilis, biuncialis, radicibus fibrosis; culmis erectis canaliculatis glabris; foliis setaceis acutis glaucescentibus carinatis culmis brevioribus hispidis; vaginis membranaceis purpureis hispidis; involucralibus 2 glumaceis, mucrone longo viridi hispido capitulum subæquantibus; capitulo singulo rarius altero, parvo atrosanguineo; squamis ovatis hispidis, marginibus ciliatis, inferioribus breviter mucronatis; staminibus tribus, antheris brunneis apiculatis; stylo trifido longiusculo, exserto; caryopsis deest.

Huilla, in pascuis breviter herbidis, cum *Xyrideis* et *Eriocaulone*, in dumosis ex Morro de Monino, versus Humpata, alibi non vidi, no. 6947.

This little plant, which is in so young a state that the form of the caryopsis cannot be accurately determined, is very near the preceding species. The leaves are numerous, setaceous or very narrowly linear, with the margins revolute, and the back cancellate.

F. BARBATA, *Isolepis barbata*, R. Br. Prod. 78.

Loanda, sparsius in arenosis maritimis ad Praia de Zamba grande et Maianga d'El Rei, Feb. 13, 1850, no. 7000.

Mossamedes, Cabo Negro, ad ripas fluminis, nunc fere exsiccati, Caroca, non adeo frequens, Sept. 1859.

Var. SUBTRISTACHYA. *Isolepis subtristachya*, Hochst. in Schimp. Pl. Abyss. no. 2166.

Loanda, frequens in sabulosis insulæ Casanga vel Cacanga, ad austrum, nec in ullo alio loco totius Angolæ antea vel postea a me visa, no. 6982.

Common also in the hotter parts of Asia and Australia. The North-American *Scirpus stenophyllus*, Ell., referred to this species as a variety by Boeckeler, seems to be distinct.

F. QUATERNELLA, n. sp. Cæspitosa pedalis, radicibus fibrosis tenuibus; culmis strictis gracilibus triquetris canaliculatis glabris; foliis setaceis glabris, dorso cancellatis, culmo multo brevioribus, vaginis ore longe albo-ciliatis, marginibus brunneis membranaceis; involucralibus 2, brevissimis, spiculam infimam subæquantibus, longe ciliatis; umbella vix patente simplici, radiis 4 raro 6, subæqualibus erectis semiuncialibus glabris; spiculis lanceolatis trilinealibus 4–6 pedunculatis, una sessili, inter radiorum bases; squamis lanceolatis oblongis carinatis hispidis, marginibus ciliatis, fusco-sanguineis, carina pallidiore, inferioribus mucronulatis, mucrone recurvo; stylo tenui trifido parum exserto rufo; caryopsi minuta obovata cordata triquetra, transversim rugosa alba; tuberculo parvo rufo; staminibus tribus.

Pungo Andongo, Pedras de Guinga, Mart. 1857, no. 6830 *b*, no. 6827; in sylvaticis apricis inter Condo et Quisonde, no. 6820; Pedra Cambondo, no. 6821; Muta Lucala.

The affinity of this plant is with *F. hispidula*, Kunth. It is distinguished by the erect equal rays of the umbel, lanceolate glumes, and small ovate-cordate nut, not $\frac{1}{3}$ of the glume in length.

F. HISPIDULA, Kunth, l. c. 227. *F. pubiculmis*, Hochst. in Schimp. Pl. Abyss.

Loanda, in arenosis tempore pluvio inundatis, prope Imbondeiro dos Lobos, Mart. 1854, no. 6985; frequens in sabulosis maritimis in silva Casanga, ad austrum Loandæ, sitæ infra Barra de Carimba, Apr. 30, 1854, no. 6983: in sabulosis prope Cacuaco, Apr. 1854, no. 6985; in pascuis arenosis pluviis sæpius inundatis prope Maianga de Povo, no. 6998 *b*, prope Penedo in arenosis, 6998 *c*.

Pungo Andongo, in dumetosis arenosis inter Præsidium et flumen Cuanza, no. 6822; ad paludes in arenosis inter Præsidium et Quilanga, no. 6831, paro cum *Polygala microdendron*, in pratis de Catete, no. 6823.

Huilla, cæspites sporadicæ, in pascuis sylvaticis de Monino, April. 1856, no. 6956, in pascuis arenosis locis æstate inundatis, Catumba et Hay, no. 6953.

Var. MINOR, Boeckeler, *F. oligostachya*, Hochst.

Pungo Andongo, in paludosis spongiosis versus austrum Præsidii, no. 6827 *b*; Catete, 6823; prope Forte de Penedo, ast rarius, Dec. 1857, no. 6998.

Huilla, inter cæspites *Xyridearum*, in pascuis editioribus ad Morro de Lopollo, no. 6946.

This species occurs abundantly all over Africa from Nubia and Bornu to the Cape, extending to Italy and South America. Nyman (Conspectus Fl. Eur. 762) suggests that it may have been introduced into Italy from America; but it seems more probable that it came originally from Africa, where it is far more common.

F. ANDONGENSIS, n. sp. Dense cæspitosa, cinerascenti-viridis, radicibus fibrosis; culmis pluribus erectis, gracilibus, subpedalibus hispidis triquetris canaliculatis; foliis erectis copiosis setaceis hispidis, culmo dimidio brevioribus; involucralibus 4 glumaceis, uno longe mucronato hispido, longe albo-ciliato; umbella pauci-radiata simplici; radiis semiuncialibus 3-4 patentibus triquetris hispidis; spiculis 4–5, lanceolatis, uno sessili; squamis lanceolatis carinatis trinerviis, mucronatis atro- vel rufo-sanguineis; carina pallidiore hispida, marginibus ciliatis, sesquilinealibus; staminibus 3, filamentis persistentibus, antheris rufis; stylo trifido longe exserto; caryopsi cordata ovata obtuse trigona alba transversim rugosa, basi angustata atra; tuberculo depresso rufo, quam squama duplo breviore.

Pungo Andongo, in pascuis subhumidis parce graminosis ad basin Pedra-sangue, juxta rivulum Casengue, ad initium Jan. 1857, no. 6823; ad rivulum Caghuy, in dumetis secundariis, in medio Jan. 1857 (plantæ juniores).

Var. GLABRA, planta glaberrima.

Pungo Andongo, in pascuis breviter graminosis rupium volcanicarum ipsius Præsidii inter *Dicrani sphagnoidei* cæspites, no. 6825.

The affinity of this plant is with *F. hispidula*, Kunth. The variety *glabra* is exactly similar to the typical form except in the absence of its conspicuous pilosity.

F. PARVA, n. sp. Semipedalis glabra cæspitosa, radicibus tenuibus; culmis gracilibus triquetris canaliculatis; foliis angustissime linearibus, triuncialibus cancellatis, marginibus revolutis, scabris; vaginis longiusculis fissis membranaceis brunneis; umbella pauci-radiata, radiis brevibus erectis inæqualibus; foliis involucralibus duobus glumaceis longe mucronatis; spiculis parvis lanceolatis oblongis; squamis ovatis lanceolatis atro-sanguineis carinatis pubescentibus, carina trinervia pallida; stylo gracillimo trifido rubro, parum exserto; caryopsi quam squama dimidio breviore obovata purpurascente, angulis flavis, trigona transversim rugosa, basi angusta flava; tuberculo minuto depresso rufo.

Pungo Andongo, ad paludes sylvaticas prope Quilanga, no. 6831, in pascuis uliginosis humidiusculis circa Præsidium, no. 6823, Feb.–April. 1857.

Affinity with *F. hispidula*, Kunth, but differing in the entire absence of pubescence, much smaller spikelets, and narrower glumes.

F. CAPILLACEA, Hochst. Herb. Ind. Hohenack. no. 939; Steud. Syn. Glum. ii. p. 111. *Scirpus capillaris*, L. Cod. 64.

Huilla, in arenosis breviter dumetosis inter Empalanca et Humpata, no. 6958, in pascuis breviter herbidis et pluvio inundatis nunc versus finem Maii ubiquitaria circa Empalanca, initio Decembris parum evoluta, no. 6958 *b*.

Pungo Andongo, Præsidium de Guinga, Jan. 1857, no. 6819.

Occurs also in Malaya, India, Abyssinia, and America.

F. HUILLENSIS, n. sp. Cæspitosa, rhizomate brevissime repente vel oblique descendente; culmis erectis gracilibus teretiusculis canaliculatis glabris, semipedalibus; foliis setaceis glaucis, culmo multo brevioribus, glabris striatis; vaginis glabris, ore ciliatis; involucralibus 2 glumaceis, capitulo brevioribus; spiculis sæpius 4–7 in capitulo congestis vel in umbella brevi-radiata, parvis lanceolatis acutis; squamis atro-sanguineis hispidis, marginibus breviter ciliatis, lanceolatis brevissime mucronatis trinerviis; stylo profunde trifido gracili parum exserto rufo; caryopsi minima ovata elongata acute triquetra alba, tuberculo magno rufo.

Huilla, in pascuis dumetosis ad oram sylvarum Catumba, frequens, init. Maii, no. 6951, in pascuis editioribus ad Empalanca denso agmine tractus longos cum *Xyrideis* et *Ascolepidibus* occupans, no. 6950.

The affinity of this plant is with *F. quaternella*, mihi. The culms are from 3 to 6 inches high, the leaves 1 to 2 inches. The larger plants have usually umbels of about 4–7 short rays. The spikelets are from 2–3 lines long.

F. COLLINA, n. sp. Cæspitosa, radicibus fibrosis; culmis erectis sed debilibus vacillantibus, obtuse triquetris, hispidis, præsertim supra; foliis angustis linearibus acutis hispidis, marginibus revolutis, culmo dimidio brevioribus; vaginis membranaceis brunneis, ore longe albo-ciliatis; involucralibus duobus setaceis brevibus basi dilatatis hispidis, uno capitulum superante; capitulo singulo, spiculis dense congestis; squamis ovatis lanceolatis, hispidulis mucronatis (mucrone recto), carinatis, atrosanguineis, carina pallidiore; stylo tenui trifido rufo; caryopsi ovata oblonga subglobosa vix trigona alba vel fulva minute cancellata, tuberculo minuto depressoconico.

Pungo Andongo, in pascuis editioribus Præsidii ad ima Pedra de S. Antonio, no. 7151.

Golungo Alto, frequens in editis (2200 ped. alt.) montosis, graminibus brevibus et fruticulis nanis obsitis, ad orientem Quilombo Quiacatubia, no. 7004; in declivibus editis montium Queta, no. 7004 *b*. *Juncum Jacquinii* simulans, in cæspites laxas aggregati.

This plant is allied to *Scirpus vestitus*, Reichb., from which it is distinguished by the solitary capitulum and larger oblong, less trigonous nut; it is also much more glabrous. The culms are from 1 foot to 1½ in height, the leaves about 6 inches, the involucral leaves very short, the longest only 1 inch long.

F. CARDIOCARPA, n. sp.; radicibus fibrosis; culmis erectis obtuse triquetris ultrapedalibus glabris; foliis angustissime linearibus acutis, quam culmi multo brevioribus; vaginis membranaceis ferrugineis ore ciliatis; involucralibus duobus basi dilatatis glumaceis longe mucronatis trinerviis capitulum subæquantibus; capitulo singulo laxiusculo; squamis ovatis acutis mucronatis carinatis trinerviis, carina lanuginosa rufa, lateribus atro-sanguineis; staminibus tribus; filamentis rufis persistentibus; stylo breviter exserto trifido rufo; caryopsi cordata trigona puncticulata rugosa, albescente nitida, quam squama ⅓ breviore, tuberculo minuto atro depresso.

Pungo Andongo, in subhumidis editioribus ad Pedras de Guinga, no. 6816.

Huilla, in declivibus herbidis humidiusculis ad Morro de Monino, no. 6948, 6960.

Closely allied to the preceding species, differing in its shorter leaves, bigger cordate nut, and almost complete want of pubescence.

F. FLEXUOSA, n. sp. Annua, bipedalis, radice fibrosa; culmis 4–6 erectis teretiusculis canaliculatis basi obtuse triquetris glabris, apice hispidis; foliis setaceis rigidulis flexuosis hispidis, culmo multo brevioribus, vaginis membranaceis ferrugineis, dorsis albo-ciliatis; involucralibus 2 angustissime linearibus vel setaceis hispidis, basi glumaceis; panicula diffusa multiramosa, ramis flexuosis hirtis gracilibus; spiculis lanceolatis involucratis; bracteolis 2, glumaceis acuminibus longis setaceis; squamis ovatis brevissime mucronatis, carinatis trinerviis hispidis rufescentibus, carina pallidiore, marginibus ciliatis; stylo trifido breviter exserto rufo; caryopsi ovata trigona basi angustata transversim rugosa alba, tuberculo minimo rufo.

Pungo Andongo, in dumetosis parce graminosis humidis inter Candumba et Mangue, 6829, in paludibus subexsiccatis prope Banza do Sola de Umbilla, rarior, 6828, pars.

This plant is allied to *F. coleotricha*, Hochst., and *F. Schweinfurthiana*, Boeckeler. It is remarkable for its large panicle with slender flexuous branches, and for being an annual. The culms are almost terete above, with a few rather deep grooves, and when dry are straw-colour. The panicle and bracts in young specimens are erect, the bracts being longer than the panicle. The nut is small, only one third of the length of the glume.

F. ORITREPHES, n. sp.; rhizomate repente crassiusculo, radicibus validulis lanatis; culmis dense seriatis pluribus gracillimis bipedalibus vix triquetris sulcatis hispidis; foliis angustissime linearibus acutis, quam culmi multo brevioribus hispidis; vaginis fissis cupreis multistriolatis, ore ciliatis; umbella pauci-radiata, radiis longis gracilibus; involucralibus 2 glumaceis longe aristatis; spiculis parvis lanceolatis; squamis ovatis lanceolatis obscure trinerviis atro-sanguineis marginibus albo-ciliatis; stylo trifido parum exserto; staminibus tribus; antheris conicis rufis, filamentis complanatis; caryopsi ovata globulosa squama duplo breviore, flavescente minute punctato, tuberculo parvo rufo.

Golungo Alto, frequentissimus in montosis editis (2200 ped.) breviter graminosis ad orientem Banza de Quilombo, no. 7016: in curte graminosis decliviis montium Queta; jam longe defloratus Jan. 1855, no. 7020.

A tall slender plant with numerous culms springing close together from the rhizome; leaves not more than 5 inches in height, and a very depauperate umbel of three rays, each bearing a spikelet, with a sessile one at the base of the rays. Sometimes there is but a single spikelet on the end of the culm. The spikelets are usually about 2 lines long.

F. HILDEBRANDTII, Boeckeler, Flora, 1875, p. 263.

Loanda, frequens in arenosis maritimis ad Praia de Bispo et Samba grande, no. 6998; ad viam ad Calumba prope Loanda, no. 6986; Quicuje, no. 6996, in sabulosis prope Museque de Luiz Gomes, no. 6984; Ambriz in collinis sabulosis prope vicum Ambriz, frequentissima et polymorpha, no. 7001.

Pungo Andongo, in paludosis prope Luxillo, no. 6823 (pars), no. 6822; Calunda, no. 6828 (pars).

Huilla, in collinis siccis breviter dumetosis inter Nene et Ferrao da Sola, no. 6954.

Var. EGREGIA. Culmis sæpius paucioribus brevioribus, umbella magis decomposita; spiculis pluribus et majoribus, semiuncialibus.

Huilla, in cultis neglectis circa Sonsala do Monino, no. 6957, nunc ad finem Aprilis fere ubique communis, Lopollo, Februario 1860.

Pungo Andongo, Lombe, cum Gentianeis, Martio 1857, no. 6833.

This species was described from specimens collected by Hildebrandt in Zanzibar, and, as far as I am aware, has not been gathered since. It seems, however, to be common in Angola. The variety *egregia* is a shorter and more compact form, with larger and more numerous spikelets.

F. MEGASTACHYS, n. sp. Cæspitosa, glabra, bipedalis et ultra, rhizomate vix repente; culmis validulis, strictis, obscure triquetris canaliculatis; foliis copiosis triuncialibus setaceis glaucis rigidis minute cancellatis, vaginis ferrugineis; involucralibus 4 brevissimis glumaceis mucronatis; radiis umbellæ 4, rarius 2 vel 3, subæqualibus; spiculis oblongis obtusis magnis, una sessili, 4–2 pedunculatis; squamis oblongis obtusis hispidis, marginibus ciliatis carinatis trinerviis sanguineis, carina pallidiore; stylo breviter trifido elongato exserto rufo; caryopsi ovata trigona transversim rugosa alba, angulis costatis, quam squama duplo breviore, tuberculo grandiusculo.

Huilla, in collinis siccioribus ad oram sylvarum prope Catumba, frequens, ad finem Martii et initium Maii 1860, no. 6952. Cæspitem fingens simulantem *Armeriæ*.

Closely allied to the preceding, but distinguished by the large oblong many-flowered spikelets, the oblong blunt glumes, absence of cilia on the vaginæ and glumaceous involucral bracts.

SCIRPUS FLUITANS, L. Sp. pl. 48.

Huilla, ad ripas arenoso-argillaceas rivi Quipumpunhine, Sobata Humpata, frequenter longas plagas virore amœnissimo decorans, Oct. 1859, nunc erecta in limosis late-cæspitosa, nunc maximis cæspitibus in rivi aquis fluitans, no. 6965; in rivulis in planitie Humpatensi frequens, 3–5-pedali, Mart. 24, 1860, no. 6966 [a very long slender form] in paludibus rivulosis prope Mumpulla cum *Otteliis*, *Xyridibus*, *Junci*sque, Oct. 1859, no. 6967 [a long trailing form apparently rooting at the nodes].

This plant is distributed over the whole of this hemisphere from Scandinavia to Tasmania.

S. SPADICEUS, Boeckeler, Linnæa, xxxvi. p. 493. *Nemum spadiceum*, Desv. Ham. Prodr. 13. *Schœnus spadiceus*, Vahl, Enum. ii. 210, *Eriocaulon spadiceum*, Lam. Ill. i. p. 214.

Var. CILIATUS. Spiculis minoribus ovatis sæpius 2, rarius 3; squamis "jam in vivo fere nigris, halitu purpureo-fusco," marginibus capillis albis ciliatis; caryopsi nigra nitida.

Pungo Andongo, in summis Pedra Sangue, locis paludosis, April. 1857; in pascuis humidis editis ejusdem loci et Cazella, Jan. Febr. 1857, no. 6836; in rupestribus breviter herbidis subhumidis prope Catete ipsius Præsidii, denso agmine crescens, no. 7166.

This is a very beautiful variety, and may perhaps be a distinct species; but the only specimens of the typical plant which I have seen are not in a very good condition, and the plant wants reexamining with a better suite of specimens. In what may be taken, from the description, as typical *Nemum spadiceum*, Desv., the spikelets are solitary, more cylindrical, sometimes as much as half an inch in length, more lax, with chestnut-coloured glumes, and without any trace of ciliation. In these respects the plants collected by Afzelius and Smeathman in Sierra Leone, in Herb. Brit. Mus., and by Morson, in Herb. Kew., all agree. All, however, seem to be in the same condition—in fact, almost past the flowering state; this may account for the laxity and paler colour of the spikelet. Steudel, Syn. Glum. ii. 106, refers with doubt to this species a plant gathered by Jardine "in Insulis Loss, Guinea." He says of it, "squamis spadiceis (coloris *Trifolii spadicei* florum)" and Boeckeler, in Linnæa, l. c., describes the glumes of both African and West-Indian specimens as "ferrugineo-sanguinescentibus;" both of these descriptions agree with the plants of Smeathman and Morson. Boeckeler describes the nut as "fuscescens straminea nitida;" but it is probable that in his specimens it was not ripe, or possibly it may vary in colour, as it does in some other Cyperaceæ. In all the plants which I have examined, the colour is black and shining by reflected, and chestnut by transmitted light, and Steudel, l. c., says of Jardine's plant "caryopsi brunnea tandem nigrescente." Boeckeler gives the height of the plant as 11–7 inches. Dr. Welwitsch's plants vary from 2 inches to 2 feet. The plant is also recorded as having been gathered in S. Domingo, in the West Indies (Lamarck, l. c.), but apparently not of late years.

S. ARTICULATUS, L. Sp. pl. 47. *Isolepis prælongata*, Nees, Wight. Bot. 108; *I. senegalensis*, Hochst. Herb. un. it. no. 1194.

Pungo Andongo, rarissimus in sylvestribus editioribus ad Pedras de Gunga, circa stagna profunda cum *Lythraceis*, Martii 1857, no. 6850.

Var. MAJOR, Boeckeler. *S. articulatus*, Rottb. l. c. 53.

Congo, late cæspitosa ad margines stagni Lagoa de Quizemba, socialis cum *Cypero articulato*, Nov. 1853, no. 6978.

Icolo e Bengo, frequens circa lacum dictum Lagoa da Funda, Sept. 1857, no. 6979.

Abundant in Tropical Africa and Asia, and occurring also in Australia.

S. CUBENSIS, Kunth, Enum. ii. 172. *Anosporum cubense*, Boeckeler, l. c. 359; *Oxycarium Schomburgkianum*, Nees, Cyp. Bras. 90; *Isolepis echinocephala*, Oliver, in Linn. Trans. xxix. 167.

Dande, rarior (unico loco visus), in terra humosa ab inundatione fluminis Dande relicta, ad ejus dextram ripam prope Bombo, no. 6994.

Pungo Andongo, in paludibus cum *Phryni* specie socialis, prope Umbilla ad flumen Cuanza, Quisonde, no. 6848.

In Africa it has occurred also by the Nile, lat. 2°, and near Khartoum (Grant), and on the White Nile (Werne), and is also a native of the West Indies and South America.

S. CORYMBOSUS, Heyne and Roth. Nov. pl. spec. 28.

Cazengo ad et in rivulis montanis prope Palmira, postea in Varzea d'Isidoro prope Sange, no. 7015 *b*, 7015 (6 to 10 feet in height).

Huilla, ad ripas lacus Ivantala cum *Polygonis* et *Commelynis* natantibus, Feb. 1860.

Ambaca, ad stagna juxta ripam dextram fluminis Lucala, Oct. 17, 1856.

Var. β MICROSTACHYUS, Boeckeler. *S. brachyceras*, Hochst. in Schimp. Abyss. no. 288.

Pungo Andongo, ad paludes inter Condo et Quisonde non procul a flumine Cuanza, Maio 1857, no. 6849.

Huilla, in paludosis juxta rivum Catumba, versus Hay, frequens, socialis cum *Typha angustifolia*, et in vicinitate *Otteliarum*, Maio 1860, no. 6977.

Principally used in the manufacture of matting. The var. α occurs also in India, var. β also in Abyssinia and Madagascar.

Dr. Boeckeler, Cyp. Berl. Herb. p. 474, describes the nut of this plant as "applanato-granulata stramineo-fuscescente." In all the specimens I have seen it is marked with short transverse ridges, and the mature nut is black and shiny; the "squamulæ" are also frequently setiform and not flattened.

S. SUBULATUS, Vahl, Enum. ii. 268.

Mossamedes, in stagnis profundis subsalsis et dulcibus prope Aguadas, no. 6973.

Pungo Andongo, in pratis paludosis ad flumen Cuanza, prope Umbilla; ad salinas ad Dungo, prope Quitage, Mart. 1857, no. 6847.

Culmi 8–9-pedales et immo altiores, glaucissimi, digiti maximi crassitudine.

This plant occurs also in India and the Cape.

S. MARITIMUS, L. Cod. 65.

Congo, in dumetis prope Quizembo, longe ab oceano et immo a flumine Quizembo remotus cum *Kyllingiis* et *Convolvulo soldanoide*, no. 6992; Lagoa de Quizembo, no. 7003.

Var. MACROSTACHYUS.

Icolo e Bengo, frequens ad Lagoa da Funda, no. 6980. Mossamedes, in uliginosis non procul ab Oceano Atlantico prope Giraûl, Julio 1859, no. 6974.

Var. AMENTIFERUS. Validus; culmo robusto; foliis longissimis latis; ramis paniculæ longis recurvis; spiculis valde elongatis cylindricis pallide brunneis.

Bengo, in paludosis inundatis ad sinistram ripam fluminis Bengo, prope Funda, nec alibi a me visus, Sept. 1854.

A very robust plant, with a stout stem, broad leaves, nearly half an inch across, and long pale spikelets 2 inches in length and $1\frac{1}{2}$ line in diameter, having more the appearance of catkins than spikelets.

Var. TERRESTRIS; rhizomate lignoso-tuberoso; radicibus crassis; foliis viridibus flaccidis; spiculis aggregatis ovatis; squamis brunneis; carina et mucrone pallide lutescentibus.

"One of the most troublesome weeds in the cotton plantations; in the fields of Mossamedes, alas, too common, July 1859, no. 6972."

It is impossible to separate specifically any of these varieties from *S. maritimus*, L., though the two latter ones appear very dissimilar at first sight. A great deal of the variation is doubtless caused by their unusual habitats. The species is probably the most widely distributed of Cyperaceous plants, ranging from Iceland to New Zealand.

S. NOBILIS, n. sp. Planta alta, 6–12-pedalis; culmis erectis validis triquetris foliatis angulis scabris; foliis late linearibus acuminatis culmum superantibus glaucescentibus; vaginis longis truncatis striatis ore scariosis; panicula magna decomposita patula; radiis circiter 10, valde inæqualibus scabridis triquetris, ocreis bracteolas subæquantibus pallidis membranaceis breviter laminiferis integris lanuginosis; involucralibus pluribus elongatis angustis; spiculis ovatis lanceolatis semiuncialibus 1–3 in apicibus radiorum; squamis lanceolatis mucronatis, marginibus laciniatis, fulvo-brunneis, mucrone longo recurvo acuto scabro, carina canaliculata scabrida; stylo longo exserto trifido; setis 6 retrorsum scabris, brunneis; staminibus tribus, longe apiculatis, apiculo conico hispido rufo; caryopsi oblonga fusiformi obscure trigona olivacea nitida, quam squama dimidio breviore.

Mossamedes, ad ripas arenosas fluminis Maiombo, frequens et quasi sylvulas formans densissimas, Oct. 1859, no. 6975.

Also S.W. Africa, lat. 23°, Messrs. Chapman and Baines, in Herb. Kew., and Madagascar, Forbes, Herb. Brit. Mus.

A very beautiful plant, most nearly related to *S. maritimus*, L.

S. REHMANNI, n. sp. Humilis, glabra; culmis bipollicaribus striatis acute triquetris; foliis linearibus acutis, quam culmi brevioribus; vaginis purpureis fissis costatis; spiculis pluribus in capitulo dense congestis; foliis involucralibus 4–5-linearibus acuminatis longis reflexis, basi purpurea vix dilatatis; squamis ovatis purpureis 5-costatis, mucrone longissimo, curvo, viridi; caryopsi minuta oblongo-oblanceolata, subcylindrica, brevissime apiculata, quam squama duplo breviore, purpurea, minute punctata.

Huilla, in arvis humidis argillaceo-arenosis post cerealium messem frequens, circa Lopollo, ad fin. Maii 1860, no. 6771. Capitula viridia.

This species is nearly related to the Russian *S. hamulosus*, Stev., but differs notably in the much longer mucrones of the glumes. The involucral bracts are rather long, attaining the length of an inch, and the capitula are half an inch in diameter. The plant has also been obtained by Dr. Rehmann, at Griffin's Hill, East Court, in Natal (Herb. Brit. Mus.), whose name I have great pleasure in associating with it.

FUIRENA CHLOROCARPA, n. sp.; rhizomate breviter repente, radicibus crassiusculis; culmis paucis pedalibus et ultra, foliatis; foliis 5–8 glabris linearibus acuminatis carinatis; vaginis acute triquetris striatis, inferioribus plerumque glabris ampliatis, ore pubescentia alba vestitis, vagina suprema omnino pubescente, ligulis truncatis ferrugineis; capitulis 2–5; spiculis lanceolatis congestis, subpentastichis; squamis late ovatis obtusis, obscure trinerviis cinereis, sanguineo-punctatis, basi rufescentibus; marginibus ciliatis, mucrone brevi, parum curvo cinereo; staminibus 3, filamentis rufis; setis tribus tenuibus curvis retrorsum scabris; stylo trifido longiusculo exserto rufo; caryopsi ovata lanceolata trigona utrinque angustata viridi-flava nitida.

Huilla, in paludosis ad arvorum margines in Lopollo; in horto Coloni Kneissmann, initio Aprilis 1860, no. 7113.

Also Abyssinia, Schimper, Coll. recent. no. 1293, and Madagascar, Hilsenberg & Bojer, in Herb. Brit. Mus.

This plant seems to connect the genus *Pentasticha* with *Fuirena*, to which genus the only known species of *Pentasticha*, *P. stricta*, Turcz., was originally referred by Kunth. In the younger spikelets the pentastichous arrangement of the glumes is quite evident, and in the absence of staminodes, the form of the setæ, and the narrow leaves and strict habit, it seems closely allied to *Pentasticha*; but the form of the spikelets when fully developed, the hairy ovate glumes, with a mucro nearly as long as that of other *Fuirenæ*, distinguish it clearly from the *Pentasticha*. The nut is beaked at both ends, the beaks being slightly curved, and is greenish yellow when ripe; the setæ are about as long as the nut.

F. PUBESCENS, Kunth, Enum. ii. 182.

In paludosis, ad rivum Casaballa, Sobati de Bumba, ubi crescit inter herbas altas quasi scandens, no. 7116.

A native of India, South Africa, and the Mediterranean region.

F. GLOMERATA, Lam. Ill. i. 150.

Loanda, rarius ad Represa de Maghelaes, non procul a Forte de Conçeiao, Julio 12, 1854, no. 7107.

Abundant in the warm countries of the Old World.

F. PYGMÆA, Welw. MS. Cæspitosa viridis, radicibus tenuibus; culmis erectis gracilibus foliatis subpedalibus; foliis circiter sex, angustis linearibus acuminatis hispidis strictis ecarinatis, vaginis ampliatis striatis canaliculatis; capitulis duobus rarius singulis; spiculis glomeratis lanceolatis parvis; squamis late ovatis griseis, sanguineo-maculatis hispidis, mucrone longo excurvo pallido hispido, carina trinervia; staminodiis nullis; setis nullis; stylo brevi gracillimo breviter trifido rufo; caryopsi minuta ovata triquetra breviter apiculata lucida lutescente.

Pungo Andongo, Sansamanda, et in paludosis graminosis arenosis sylvestribus inter Mopopo et Sansamanda, Feb.–Maio 1857, no. 7111, 7171.

Huilla, gregatim in apricis sylvaticis humidiusculis *Scytonemate* fusco-sanguineo obductis, ad Monino, April. 1860, no. 7112.

This species is closely allied to *F. pubescens*, Kunth, but is distinguished by the absence of staminodes and the shape of the nut. The spikelets also are smaller, only $\frac{1}{4}$ inch in length.

F. CINERASCENS, Boj.

Huilla, in pratis humidis sylvaticis ad Catumba, ad finem Martii 1860. Tota planta quasi carnosula et rigida.

Occurs also at Zanzibar.

F. PACHYRRHIZA, n. sp.; rhizomate repente valido, radicibus crassis; culmis erectis validis triquetris $1\frac{1}{2}$–2-pedalibus foliatis; foliis late linearibus acuminatis longis, carinatis, minute pubescentibus; vaginis ampliatis striatis pubescentibus triquetris, ligula cylindrica integra brunnea; umbellis 3–4 terminalibus et lateralibus; spiculis magnis oblongis lanceolatis; squamis ovatis lanceolatis obtusis hispidis trinerviis, mucrone longe recurvo, cæruleo-cinereis, demum rufescentibus; staminodiis nullis; stylo longo gracili tenui plumoso rufo; caryopsi parva ovata, triquetra, utrinque angustata, apice tuberculata, atra nitida tricostata, quam squama duplo breviore; tuberculo magno albo triquetro.

Pungo Andongo, in uliginosis sylvaticis inter Caghuy et flumen Cuanza, cum *Isoetis*, April. 1857, no. 7118; prope Muta Lucala, no. 7117.

The culms of this plant are from $1\frac{1}{2}$ to 2 feet in height; the leaves often 6 inches in length, by $\frac{1}{4}$ to $\frac{1}{3}$ inch broad; spikelets $\frac{1}{2}$ inch in length; glumes $2\frac{1}{2}$ lines long; caryopsis one third of the glume in length. The shape of the nut is remarkable, dilated at the middle and narrowed towards either end. The base of the style is developed into a blunt triquetrous process, white in the ripe fruit, the rest of which is black and shining.

F. WELWITSCHII, n. sp.; rhizomate longo repente tenui lignoso brunneo, radicibus paucis crassis; culmis remotis strictis triquetris foliatis; foliis paucis anguste linearibus acutis carinatis strictis cancellatis, marginibus carinaque pauci-ciliatis, vaginis ampliatis triquetris striatis, ligula brevi pubescente oblique truncata brunnea; spiculis 3–12 laxe aggregatis, lanceolatis; squamis ovatis, mucrone longo recurvo, trinerviis cinereis valde pilosis; staminodiis nullis; stylo gracili longo, trifido; caryopsi ovata utrinque angustata, tricostata, basi styli conica subacuta.

Pungo Andongo, in paludosis prope Quibanga, Jan. 1857, no. 7108.

Huilla, in pascuis humidiusculis prope Lopollo, frequens, Dec. 1859–Jan. 1860, no. 7114; in declivibus graminosis ad Morro de Monino, fin. Apr. 1860, no. 7109; in collinis arenosis siccioribus prope Eme, ad finem Feb. 1860, no. 7115.

This plant varies very much in size and form. In damp wooded spots it is tall and much drawn up, attaining a height of $1\frac{1}{2}$ foot, with leaves 6 inches in length and $1\frac{1}{2}$ line in breadth, and larger flower-spikes. In dryer sandy spots (no. 7115) it is short and stunted, with the culms only about 6 inches high, and the leaves shortened in proportion to 1 inch.

HEMICARPHA ISOLEPIS, Kunth, Enum. ii. 268.

Pungo Andongo, Sansamande April. 1867, no. 6814; in paludosis cum *Neottia*, Lombe, no. 6815; in pratis sylvaticis inter Quisonde, no. 6818.

Huilla, in pascuis editis ad Empalanca locis tempore pluviali inundatis, socialis cum *Xyrideis*, &c., no. 6963.

Occurs also in Gallabat, the Cape, and India.

H. SUBSQUARROSA, Nees, Cyp. Bras. p. 61.

Loanda, in arenoso-argillaceis ad margines stagnorum prope Conçeiao, at non frequens, jam deflorata Jul. 12, 1854, nos. 6981, 6996.

A native of North and Tropical South America.

LIPOCARPHA SPHACELATA, Kunth, Enum. ii. 267.

Pungo Andongo, in pratis udis subarenosis prope Mopopo, ad flumen Cuanza, April. 1857, et Lombe, no. 6776.

Occurs also in Senegal, India, Central and South America.

L. ATRA, n. sp. Glabra, rhizomate subrepente, radicibus crassiusculis, rufis; culmis pluribus erectis rigidis subpedalibus, obtuse triquetris canaliculatis; foliis rigidis linearibus obtusis, culmis multo brevioribus; vaginis integris ore membranaceis truncatis purpureo-punctatis; involucralibus 2, uno longissimo 1–1½-pollic., altero spiculas subæquante, linearibus obtusis rigidis, basi dilatatis; spiculis 4–5 confertis divergentibus cylindrico-conicis aterrimis; squamis imbricatis obovatis, cuneatis breviter mucronatis atro-sanguineis; rhacheola crassiuscula, basi dilatata, foveolis minimis; stamine uno; squamulis interioribus 2, tenuissimis; stylo 3-fido, gracili brevi rufo; caryopsi oblongo-lanceolata (immatura).

Huilla, in uliginosis juxta ripas fluminis Cacolovar, prope lacum Ivantala, non frequens, Feb. 1869, postea etiam prope Humpata, in arenosis, no. 6961.

Allied to the preceding, but differing in the stouter habit, rigid leaves, longer and more cylindrical black spikelets, and smaller flowers. The leaves are about one third of the culms in length, the culms 6–8 inches high, the spikelets one fourth of an inch in length, with the small glumes closely imbricated.

L. PULCHERRIMA, n. sp. Cæspitosa, glaucescens, radicibus pluribus; culmis gracilibus, subteretibus, vix triquetris striatis, 3–10-pollicaribus; foliis angustissime linearibus acutis striatis culmo duplo brevioribus, vaginis fissis striatis purpurascentibus; involucralibus 2, uno longissimo (fere triunciali), altero breviore, patentibus, basi vix dilatata; spiculis 3–4 glomeratis, lanceolatis, subcylindricis; rhacheola cylindrica, foveolis minutis; squamis cuneatis striolatis lateribus atro-purpureis, dorso mucroneque luteis, mucrone longo excurvo; squamulis interioribus 2, oblongis lanceolatis tenuissimis, 5-nerviis; caryopsi ovali-oblonga rufescente minute punctata.

Pungo Andongo, Catete, nos. 6774, 6785 (pars); ad paludes apricas Præsidii et prope Quilanga, Feb. 1857, no. 6774.

Huilla, in arvis arenoso-argillaceis post *Sorghi* plantationes frequentissima, et cum multis aliis scirpoideis et eriocauloneis sociata, dense pulvinata, April.–Maio, 1860, no. 6775.

A very distinct plant, with slender culms and leaves and the spikelets closely compacted, a quarter of an inch in length. The glumes are of a deep claret-colour, very finely striated, broadest at the apex, with a very long curved mucro, which, with the carina, is yellow.

L. ARGENTEA, R. Br., in Tuckey's Voy. Congo, p 459.

Pungo Andongo, ad rivulum Calunda in convallibus rupestribus Præsidii, in medio Jan. 1857, no. 6778.

Huilla, ad stagna sylvatica in sylvis mixtis de Monino, rarior, versus finem Martii 1860, no. 6777.

Occurs also in Madagascar, India, Malaya, and South America.

L. ALBICEPS, n. sp. Glaucescens, rhizomate repente tenui, stolonifero; culmis singulis gracilibus striatis triquetris sesquipedalibus; foliis setaceis culmo brevioribus, vaginis fissis striatis; foliis involucralibus duobus patentibus demum recurvis, uno longo, altero breviore; spiculis 4 vel 5, arcte glomeratis ovatis albis; squamis parvis anguste lanceolatis acuminatis supra albis, basi purpuratis; squamulis duobus lanceolatis trinerviis; stamine uno; stylo trifido brevi; caryopsi parva ovata lanceolata trigona punctata fulva.

Pungo Andongo, in pratis paludosis prope Catete cum *Ascolepidibus*, no. 6786; in decliviis spongiosis Præsidii cum aliis glumaceis et *Ascolepidibus* intermixta, no. 6785, ex parte. Sansamande, no. 6786.

This plant, at first sight, looks like a slender form of *L. argentea*, R. Br., but is distinguished by its slender rhizome, setaceous leaves and culms, shorter ovate spikelets with lanceolate, somewhat spreading, glumes (very different from the almost cylindrical spikelets of *L. argentea*), and the small and narrower nut. The culms measure from 8 inches to $1\frac{1}{2}$ foot. The leaves sometimes attain a length of 10 inches; the spikelets are $\frac{1}{4}$ inch in length; in glumes $1\frac{1}{4}$ line in length by $\frac{1}{3}$ line in breadth. The latter are white above; but the base is dark purple or blood-red, which, however, is generally not visible till the glume is removed. The nut is $\frac{1}{2}$ the scale in length.

L. PURPUREO-LUTEA, n. sp. Glauca, rhizomate repente crasso lignoso; radicibus validulis; culmis singulis 5–7-pollicaribus rigidis triquetris; foliis paucis rigidis linearibus obtusis recurvis, culmo brevioribus; vaginis integris ore membranaceis purpurascentibus, vetustis multis brunneis persistentibus; foliis involucralibus duobus vel tribus, demum patentibus, uno 1–$1\frac{1}{2}$-pollicari, altero breviore, linearibus rigidis basi dilatatis purpuratis; spiculis 3–5 glomeratis ovatis; squamis ovato-cuneatis, acuminatis striolatis, acumine dorsoque luteis, lateribus atro-sanguineis; squamulis duobus, ovatis lanceolatis, uno apice purpurascente; staminibus tribus, apiculatis, apicula conica, antheris fulvis, filamentis latis crassis; stylo bifido basi incrassato; ovario obovato; caryopsis deest.

Huilla, in pascuis dumetosis æstate inundatis, prope Humpata, Martio 1860, no. 6784.

This plant is remarkable for the long woody rhizome throwing up distant tufts of leaves; the old leaf-sheaths of the tufts of the preceding years persist, forming brown stumps; the leaves, few in number, are 2–3 inches in length, rather stiff and recurved. The bracts, at first erect, finally spreading, are similar; one is about $1\frac{1}{2}$ inch in length, the other half an inch. The glumes, dark blood-colour, with a yellow carina and apex, are numerous and closely imbricate. The inner glumes, which enclose the flower, are more cartilaginous than in most of the other species, and one is coloured purple at the apex. Unlike any other species with which I am acquainted, there are three stamens in the flower; they are brownish yellow in colour, and terminated by a short conical apiculus; the filament was, in all the specimens examined, very short and thick; but the plants were in quite young flower, and it seems likely that they would increase in length as the flowers developed.

HYPOLYTREÆ.

Ascolepis, sect. Eu-ascolepis.—All the species of this subgenus collected by Dr. Welwitsch in Angola were described by him in Trans. Linn. Soc. xxvii. p. 74. There are four species, all previously undescribed, viz. *A. protea*, Welw., *A. anthemifolia*, Welw., *A. speciosa*, Welw., *A. elata*, Welw. *Rhynchospora ochroocephala* was a name given by Boeckeler ('Flora,' 1879, p. 568) to a plant collected by Pogge in Kimbundo, West Africa, which he says, in a note to the description, was called an *Ascolepis* by Dr. Ascherson (Botan. Verein d. prov. Brandenburg, Abhandl. 1878), on the authority of Dr. Welwitsch, who found the plant in Angola. Dr. Ascherson (*l. c.*) mentions *Ascolepis protea* among Pogge's plants, which is presumably Boeckeler's *Rhynchospora*, though the distribution number (1) is not quoted. Boeckeler's description does not, however, agree at all with *Ascolepis protea*, nor, indeed, with any species of *Ascolepis* in Dr. Welwitsch's herbarium. I conclude, therefore, that there has been some error in identifying the plant with one of Dr. Welwitsch's *Ascolepides* *.

A. (§ Platylepis) capensis, Kunth, Enum. ii. 269.

Huilla, in spongiosis, prope Lopollo, frequens, Morro de Lopollo, Oct.–Dec. 1859, no. 1676; frequentissima una cum *Eriocauloneis* in pratis spongiosis breviter herbidis; Morro de Monino, in paludosis, socialis cum Orchideis (*Disa* et *Habenaria*, sp.) in editioribus. Flores et fructus, Feb.–Mart. 1860, no. 1677. Serra d'Oiahoa, April. 1860, no. 1677 *b*; in paludosis, prope Ferrao da Sola, no. 1676 *b*. "Stirps elegantissima, floribus (glumis) lacteis."

A native also of South Africa.

A. (§ Ptatylepis) pusilla, n. sp. (Plate XXIII. figs. 10–14.) Humilis, parce cæspitosa, glabra, radicibus fibrosis; culmis erectis $1\frac{1}{2}$-pollicaribus striatis obscure triquetris; foliis paucis setaceis vel anguste linearibus, culmo multo brevioribus; vaginis fissis chartaceis purpurascentibus striatis; involucralibus 3 longis erectis demum reflexis anguste linearibus, basi late dilatata; spiculis tribus ovatis arcte compactis albis (in vivo); rhacheola cylindrica, spongiosa medio incrassato; floribus

* Since writing the above I have, through the kindness of Dr. Ascherson, had the pleasure of seeing the type of *R. ochroocephala*, Boeckeler. It is a very remarkable plant, at first sight closely resembling *Ascolepis protea*, Welw., but apparently a true *Rhynchospora*.

copiosis parvis; squamis lineari-lanceolatis purpureis squamellas subæquantibus; squamellis obovato-cuneatis abrupte acuminatis costatis plano-compressis, acumine curvo; stylo breviter trifido purpureo e rima orbiculari extruso; caryopsi triquetra subcompressa oblonga purpurea minute punctata.

Huilla, in pascuis sylvaticis macris humidioribus, circa Lopollo et Monino vix florens medio Aprilis, cum fructibus initio Maii 1860, no. 1678; in arvis post messem *Sorghi* frequens ad finem Maii 1860, no. 6773, plantæ juvenes.

This is a very small species, with somewhat the habit of *Scirpus hamulosus*, Stev., about 1 or 1½ inch high, with narrow leaves ½ inch in length or less. The involucral leaves are usually longer and broader than the radical leaves, and attain a length of one inch; the bases are broadly ovate, with several rather prominent ribs, which are sometimes forked, as in *A. capensis*. The capitula are closely compacted, and resemble those of a small *Kyllinga*. The flowers are very small and narrower than in *A. capensis*. The three-cleft style, with the bluntly triquetrous nut, also serve to distinguish it from the other species. As it has three spikelets, it must be referred to the section Kyllingioides, which includes also *Platylepis braziliensis*, Nees.

The remaining species of the genus are also Tropical African, one of which occurs besides in South America.

RHYNCHOSPOREÆ.

Remirea maritima, Aublet, Fl. Guian. i. 45.

Mossamedes, denso agmine crescit, stolonibus 6–15-pedalibus, absque flore habitu *Statices* quasdam Lusitanicas fingit. Habitat in sabulosis maritimis ditionis dictæ Marquezado do Mossul, non procul ab ostio fluminis Ongo vel Onzo, Nov. 1853, no. 6990.

Widely distributed in the littoral regions of the tropics of both worlds.

Rhynchospora aurea, Vahl, Enum. ii. 291.

Pungo Andongo, in paludosis cum Scitamineis, Umbilla, Quisonde ad Cuanza, Martio 1857, no. 6844; in paludibus ad Lagoa de Quibinda, in aquosis profundis habitans, no. 6845.

A widely distributed tropical plant.

Schœnus erinaceus, n. sp. (Plate XXIII. figs. 5–9.) Herba glabra, stolonifera, stolonibus squamis magnis ovatis lanceolatis tectis; culmo singulo erecto, fistuloso, teretiusculo apice triquetro tripedali glauco, striato, basi subbulboso; foliis paucis linearibus striatis flaccidis complanatis longis; vaginis integris longis, ore membranaceis; capitulo magno niveo; foliis involucralibus 2-3, longissimis linearibus acutis patentibus; spiculis copiosis dense aggregatis patentibus, linearibus lanceolatis magnis, compressis; squamis anguste lanceolatis acutis striatis, margine scariosis, minute serratis subdistichis ecarinatis, infimis ovato-lanceolatis 7 vacuis, terminali hermaphrodita; staminibus longissimis tribus; ovario lanceolato; stylo gracili brevissime trifido complanato, quam squama breviore; setis nullis; caryopsis deest.

Huilla, in alte herbidis sylvaticis juxta rivulum Monino et Mumpanda, no. 6788; capitula nivea erinaceo-horrida; est hæc avis rara solummodo hoc loco a me visa, cum floribus, initio Aprilis 1860.

I have referred this remarkable plant to the genus *Schœnus* on account of its almost distichous glumes, non-bulbous base of style, and slightly flexuous but very short rhachilla. It is, however, very distinct from the other species of the genus. From the swollen base of the solitary culm are emitted rather stout stolons, covered thickly with large scale-leaves. The stem-leaves, few in number (2 or 3), are about 1 foot long and 2 lines in diameter, the involucral leaves 5 to 8 inches in length. The spikelets, $\frac{1}{2}$ inch in length, are very much flattened, the lower glumes being almost completely distichous, the upper ones less so. The terminal glume alone enwraps a flower, which consists of 3 stamens and a short pistil, without any hypogynous bristles. The stamens are unusually long, both in filaments and anthers. In most of the more advanced flowers two of the stamens projected from the apex of the glume, while the third remained enclosed within it. The pistil is shorter than the enclosing glume; it has 3 very delicate short stigmatic arms. The ovary is subcylindrical, tapering gradually into the style; but the flowers were too young to give any idea of the form of the ripe fruit. The lowest glumes in the spikelet are the smallest, the upper ones increasing gradually in length; according to Dr. Welwitsch, they are white in the living plant, but they become a yellowish cream-colour when dry.

CRYPTANGIEÆ.

ACRIULUS GRIEGIFOLIUS, Ridl. Journ. Linn. Soc. Bot. xx. p. 336. (Plate XXII.)

Was collected at Lake Ivantala, Huilla, no. 6959. In the only specimen of this plant that I have seen, all the flowers are male. I have therefore supplied drawings of the female flowers of the other species, *A. madagascariensis*, Ridl., *l. c.*

SCLERIÆ.

ERIOSPORA ABYSSINICA, Hochst., Schimp. Pl. Abyss., no. 233.

Pungo Andongo, frequens in fissuris editiorum Præsidii, Mart.–April. 1857, no. 6841.

Loanda district; no specific locality.

Latissime cæspitosa 1–3-pedalis; foliis semper virentibus carnosulo-coriaceis lævigatissimis.

Originally collected in Abyssinia by Schimper.

SCLERIA HIRTELLA, Sw., var. ATERRIMA; foliis hispidioribus; culmis validulis; capitulis magnis aterrimis.

Huilla, in decliviis spongiosis editioribus sylvarum mixtarum ad Morro de Lopollo, frequens, at solummodo hoc loco mihi obvia, no. 7143.

The African specimens of this species are usually stouter, and with larger capitula than the American ones. The variety above described is remarkable for the large size of the nodding capitula, $\frac{1}{3}$ inch in length and $\frac{1}{4}$ in breadth, and for the black glumes and hairs, which make it a very striking plant. Besides occurring in other parts of Africa and in Madagascar, it is abundant in America from the Southern States to Brazil.

S. BULBOSA, Hochst., var. PALLIDIFLORA; foliis hirtis, marginibus ciliatis; squamis castaneis; caryopsi alba ferme lævi.

Pungo Andongo, in pratis humidis peculiaribus (e graminosis gracillimis solum com positis), prope Sobata de Muta Lucala, nec alibi a me visa, Mart. 1857, no. 7133; *Caricis arenariæ* et affinium habitu; culmus 3- rarius 4-pedalis, erectus.

In the typical *S. bulbosa*, a native of Abyssinia, the capitula are almost, if not quite, black, the leaves glabrous, with a few hairs on the nerves and margins, and the caryopsis is tuberculate, instead of being nearly smooth, as it is in this plant.

S. CÆSPITOSA, Welw. MSS. Cæspitosa, rhizomate breviter repente radicibus copiosis; culmis erectis gracilibus 2- rarissime 3-pedalibus, acute triquetris glabris; foliis erectis angustissime linearibus obtusis glabris vel parce pilosulis, vaginis integris triquetris vel parce pilosis, ore albo-ciliatis; spica simplici, fasciculis 11–12 remotiusculis; bracteola lanceolata pallida, mucrone longo ciliato; squamis inferioribus ovatis lanceolatis mucronatis, superioribus lineari-lanceolatis acutis sanguineis, carina pallida; stylo profunde trifido brevi; caryopsi globosa trigona, alba nitida obtuse mucronata, basi angustata triquetra lævi.

Pungo Andongo, frequens in pratis sylvaticis paludosis inter Condo et Quisonde, Mart. 1857, no. 7135.

One of the *Dregeana* section, nearly allied to *S. verticillata*, with strict culms and leaves, nearly glabrous. A simple spike, one or two inches long, of rather distant fascicles of spikelets, generally two together. The highest leaf on the culm does not overtop the spike.

S. ERYTHRORRHIZA, sp. n.; rhizomate repente crasso lignoso, squamis ovatis striatis secto, radicibus rubris; culmis pauci-foliatis seriatis erectis pedalibus acute triquetris glabris; foliis erectis linearibus complanatis carinatis, marginibus carinaque longe albo-ciliatis, vaginis integris inferioribus ciliatis, superioribus glabris; spica nutante, folio supremo superante; fasciculis 7, spiculis in fasciculo 3; bracteolis ovatis oblongis pallidis, margine hispido, mucrone longo viridi hispido; rhachilla acute triquetra glabra; squamis lanceolatis, inferioribus pallide ocreis sanguineo maculatis lanatis, superioribus sanguineis muticis apice fimbriatis; caryopsi lævigata.

Huilla, in pratis sylvaticis, prope ad basin Morro de Ferrao da Sola, sporadica.

This plant is related to *S. Dregeana*, Kunth; it has a stout creeping rhizome, covered with ovate pinkish scales; the culms are 14 inches high, the leaves on the upper part of the culm are 2 inches in length; they become shorter on the lower part of the culm, and pass gradually into those on the rhizome. The glumes are remarkable for the outer ones being covered with a whitish pilosity, while the inner ones are fimbriate. There were no nuts on the specimen; but Dr. Welwitsch states that they are smooth.

S. DREGEANA, Kunth, Enum. ii. 354.

Huilla, in sylvaticis alte herbidis ad Monino, unico loco a me visa, ad fin. Jan. 1860, no. 7137.

A South-African plant.

S. JUNCIFORMIS, Welw. MSS.; rhizomate repente crasso lignoso, squamis ovatis striatis tecto, radicibus rubris; culmis seriatis bipedalibus validis triquetris striatis glabris; foliis linearibus acute carinatis longis, inferioribus raro hispidulis; vaginis integris striatis ore albo-ciliatis, inferioribus purpurascentibus, angulis longe ciliatis, superioribus glabris; paniculæ ramis paucis triquetris suberectis, fasciculis compositis; spiculis linearibus glabris pallide sanguineo-maculatis vel sanguineis; bracteolis spiculis brevioribus, ovatis mucrone longo; squamis inferioribus lanceolatis breviter mucronatis, supremis lanceolatis acuminatis; caryopsi globulosa trigona minuta alba brevissime mucronata.

Huilla, in pratis sylvaticis alte graminosis, prope Catumba, no. 7138; in pratis paludosis ex Monino ad Eme, frequens, no. 7139, Jan.–Mart. 1860.

This species is closely allied to *Scl. erythrorrhiza*, but is distinguished by the tuft of white hairs at the mouths, and the long white cilia on the angles, of the vaginæ, the paniculate arrangement of the inflorescence, and the glabrous spikelets with entire lanceolate acuminate glumes. The rhizome is, as in that species, covered with ovate scales, the parenchyma of which decaying away leaves the fibro-vascular bundles. The rhizome is yellow, and resembles that of *Juncus balticus*, Willd.; the culms are somewhat distant, and 2–2½ feet in height; the leaves on the culm are 6 inches in length, excluding the vagina, and nearly always glabrous.

S. USTULATA, n. sp. Glabra 1–1¼-pedalis, radicibus fibrosis; culmis erectis paucis gracilibus triquetris foliatis; foliis angustissime linearibus obtusis, 3–6-pollicaribus striatis; vaginis plerumque glabris, rarius minute hispidis, integris purpureo-punctatis; spica semipedali; fasciculis 12–18, approximatis; spiculis 1 ♀, 1–2 ♂ in fasciculo; bracteola lineari longe acuminata, viridi, lateribus dense atro-sanguineo maculatis; squamis lanceolatis acuminatis; carina viridi, lateribus supra atris, infra ochraceis, sanguineo-maculatis; caryopsi globosa trigona brevissime mucronata, papillosa echinulata alba.

Pungo Andongo, in Andropogonetis humidis sylvestribus ad ripas fluminis Cuanza una cum *Droseris*, Mart. 12, 1857, no. 7134. Non cæspitosa, spicis e flavo, fusco et nigro variegatis.

The alliance of this plant is with *S. hispidula*, Hochst.; but it differs in being almost completely glabrous, with broader leaves and lanceolate acuminate glumes, conspicuously tipped with very dark purple or black. The culms are slender, and one to three on a plant; the spike of fascicles is 6 inches in length, and overtopped by the last cauline leaf. The nut is one line in length.

S. PULCHELLA, n. sp.; radicibus fibrosis rubris copiosis; culmis pluribus erectis triquetris glabris rarius hispidulis; foliis linearibus acutis complanatis, marginibus et carina hispidis, triuncialibus; vaginis integris, ore membranaceo, striatis purpureo-punctatis; spica raro composita, unciali; fasciculis approximatis; bracteola pallida ovata longe acuminata, acumine scabro, lateribus scariosis; rhachide flexuosa, acute triquetra;

spiculis 1 fœmina, 2 masculis in fasciculo; squamis superioribus lineari-lanceolatis, inferioribus lanceolatis acuminatis, sanguineis, carina viridi; caryopsi minuta obovata, globosa trigona basi angustata papillosa mutica alba, disco triquetro.

Huilla, in pascuis breviter graminosis editis ad Empalanca cum *Eriocaulone*, *Xyrideis* etc., Dec. 1859, Mart.–Mai. 1860, no. 7141.

A small-flowered plant, with somewhat the aspect of a *Sporobolus*, 5 to 6 inches in height, and more or less hispid. The highest cauline leaf overtops the stem; the radical leaves are from 2 to 3 inches in length. The spike is rarely slightly decompound; the fascicles of spikelets arranged rather close together. The lower glumes in the spikelets, especially in the female spikelet, are, as usual, broader and more distinctly acuminate than the upper ones. The nut is very small, being only one millimetre in length. The plant is most nearly allied to *S. hispidula*, Kunth.

S. REMOTA, n. sp. Cæspitosa, radicibus fibrosis; culmis erectis acute triquetris lateribus, striatis glabris ultra pedalibus; foliis linearibus acute carinatis, flavescenti-viridibus, parce pilosulis; vaginis integris hispidis, ore albo-ciliatis purpureo-punctatis; spica 3–4-pollicari, rhachide parce pilosa, fasciculis remotis semiverticillatis; bracteola ovata brevi mucronata scariosa pallida vel sanguineo-maculata, fasciculis breviore; spiculis lanceolatis, squamis inferioribus ovatis lanceolatis fuscescentibus vel atro-sanguineis, glabris carina viridi, mucrone brevi, supremis lineari-lanceolatis sanguineo-maculatis; caryopsi alba muricata ovata trigona-globosa, marginibus prominulis, transversim multicostata. basi haud multo angustata, mucrone longiusculo.

Pungo Andongo, in pratis humidis sylvaticis inter Serra de Guinga et Candumba, Mart. 1857, no. 7129.

Var. HISPIDA. Culmis patentim pilosis, foliorum marginibus carinisque longe albo-ciliatis; spiculis fuscescentibus pilosis.

Pungo Andongo, in decliviis editioribus humidis ad Funda Quilombo ipsius Præsidii, Aprili 1857, no. 7131; socialis cum *Fimbristyli hispidula*, Kunth, in summis Pedra Sangue, muscis intertextis, no. 7131 *b*.

Of this plant there are two forms—one almost glabrous, with very dark-coloured spikelets, the other conspicuously pilose, with rather stiff white hairs spreading from the angles of the vagina, which clothe the culms, and from the margins and keels of the leaves, and with paler hairy spikelets. The culms are usually from 11 to 14 inches high, and terminated by a spike of distant fascicles of spikelets, but, on high ground (no. 7131 *b*), become reduced to about 4 inches in height. The leaves are flat, green, and more flaccid than usual in *Scleriæ*; they are from 4 to 8 inches in length, and the terminal one on the culm is considerably shorter than the spike. The nut, 1 line in length by $\frac{2}{3}$ line in breadth, is somewhat acutely trigonous, irregularly tuberculate and muricate, especially on the angles; the apiculus is rather longer than usual.

S. DUMICOLA, n. sp. Glabra, radicibus paucis tenuibus; culmis paucis foliatis, triquetris debilibus, bipedalibus, angulis scabridis; foliis linearibus subacutis, complanatis, carinatis longis, marginibus carinaque scabris; vaginis integris striatis, angustissime trialatis, ore albo-ciliatis, ligula brunnea membranacea; spicis 2–4, brevibus; fasciculis, circiter 5, remotiusculis; bracteis linearibus acutis; squamis ovatis lanceolatis acutis breviter mucronatis, lateribus brunnescentibus, marginibus sanguineis, carina viridi; caryopsi ovata conica breviter apiculata, alba nitida, rugosa, disco trilobo, pallide ochroleuco striato.

Pungo Andongo, rarior in paludosis dumetosis inter Quilanga et Pedras de Guinga, Jan. 1857, no. 7122.

This plant is closely allied to *S. Schimperiana*, Boeckeler, but differs in absence of pubescence, paler narrower glumes, and in the shape of the nut, which in *S. Schimperiana* is depressed globose, quite smooth and muticous, and larger, and has a smaller less clearly ribbed and usually green disk. The culms are a little over 2 feet in height, one or two to a plant; the leaves attain the length of a foot. The glumes, as in *S. Schimperiana* and several other species, are darkest in colour at the edges.

S. FOLIOSA, Hochst. in Schimp. Pl. Abyss. no. 1232.

Pungo Andongo, in pratis humidis ad ripas fluminis Cuanza, prope Muta Lucala, Mart. 1857, no. 7123.

Occurs also in Abyssinia.

S. CLATHRATA, Hochst. in Schimp. Pl. Abyss. no. 1603.

Pungo Andongo, inter Caghuy et Sansamande cum *Isoete æquinoctiali*, et late cæspitosa in paludosis pratis sylvaticis editioribus ad Pedra de Guinga et Mattha de Quilanga, Aprili–Maio 1857, no. 7124.

A native of Abyssinia.

S. POŒOIDES, n. sp. Cæspitosa, rhizomate repente, radicibus rubris; culmis gracillimis triquetris subpedalibus glabris; foliis linearibus obtusis glaucescentibus ecarinatis glabris striatis, radicalibus culmo brevioribus, vaginis integris infimis dense pubescentibus; caulinis glabris basi purpurascentibus; panicula laxa, ramis gracillimis subflexuosis, fasciculis remotis parvis; spiculis una fœminea, duabus masculis, in fasciculo; squamis sanguineis pubescentibus, inferioribus ovatis mucronatis, superioribus ovatis lanceolatis obtusis; caryopsi minuta tuberculata breviter apiculata alba, apiculo truncato, ovata globosa obscure trigona.

Huilla, in arenoso-spongiosis, ad Quilebe cum fructibus et floribus, ad finem Novembris 1859, no. 7142. "Fibrillis radicalibus in vivo sanguineis carnosulis."

This plant is remarkable for its much-branched panicle of small flowers, with very slender flexuous rami, which, together with its linear grass-like leaves, give it the appearance of some species of *Poa*. The culms are from 8 inches to 1 foot in height, the leaves 4–6 inches long; the vaginæ of the lowest are pubescent, while those on the culm are quite glabrous. The branches of the panicle are at first erect, and become more patent during flowering. The fascicles are sessile and rather distant on the slender branches. The caryopsis is small, the base abruptly narrowed into a rather long triquetrous pillar. The affinity is with *S. verticillata*, Muehlb.

S. PALMIFOLIA, Hoffmansegg in Schlechtd. Bot. Zeit. 1845, 492.

Golungo Alto, in palustribus, ad ripas Rivi Cuango prope Sange, Julio 1855, Dec. 1853, no. 7128. "Schneidig wie ein Razir-Messer."

Occurs also in Tropical South America.

S. MELANOMPHALA, Kunth, Enum. ii. 345.

Pungo Andongo, ad ripas paludosas rivulorum prope Quilanga, at non frequens, Feb. 1857, no. 7145.

Huilla, frequens ad cataractam prope Lopollo, no. 7144.

"4-pedalis cæspitosa, glumis splendide atrosanguineis; acheniis alabastrinis; spicis nutantibus."

Occurs also in the Cape and Natal and Madagascar (*Hildebrandt*, no. 4015).

S. CERVINA, n. sp. Glabra, radicibus pluribus validulis; culmis 1–2 validis foliatis 2-pedalibus et ultra; foliis late linearibus acutis viridibus planis bicostatis longis; vaginis ampliatis triquetris anguste tripteris canaliculatis, integris ore ciliatis; spicis lateralibus et terminalibus longe pedunculatis, laxis circiter 7; spiculis fasciculatis pallidis; bracteolis linearibus margine scabridis; squamis ovato-lanceolatis vel lanceolatis mucronatis cervinis sanguineo-maculatis; caryopsi alba mutica ovali subtrigona lævi.

Pungo Andongo, in spongiosis inter Mutollo et Candumba, Mart. 1867, no. 7127; in paludosis prope Quilanga.

A stout, almost glabrous plant, with fawn-coloured spikelets an inch long, on peduncles 2 inches in length. Leaves 10 inches long, $\frac{1}{2}$ inch in diameter.

S. FLAGELLUM, Swartz, Fl. Ind. Occid. i. 88, t. 3.

Ambriz, ad rupes madidas inter Ambriz et Quizembe, no. 1853, no. 7125.

Occurs also in Tropical South America and the West Indies and in Sierra Leone.

DESCRIPTION OF THE PLATES.

Plate XXII.

Figs. 1–4. *Acriulus griegifolius*. 1, the plant without the culms, reduced a third; 2, the culm of the same plant, equally reduced; 3, a spikelet, enlarged; 4, a male flower, enlarged; 5, a stamen, enlarged.

Figs. 6 & 7. *A. madagascariensis*. 6, the female spikelet; 7, the pistil, enlarged.

Plate XXIII.

Figs. 1–4. *Kyllinga pauciflora*. 1, the whole plant, reduced one third; 2, a spikelet; 3, spikelet, opened; 4, pistil: except 1, all enlarged.

Figs. 5–9. *Schœnus erinaceus*. 5, whole plant, reduced one third; 6, spikelet; 7, spikelet with the glumes separated; 8, the fertile flower; 9, pistil: all enlarged.

Figs. 10–14. *Ascolepus pusilla*. 10, the whole plant, life size; 11, flower from in front; 12, flower from behind; 13, flower from the side; 14, the pistil: except 10, all enlarged.

E.C. Knight ad nat lith   1-5. ACRIULUS GRIEGIFOLIUS. 6-7. A. MADAGASCARIENSIS.   West, Newman & Co imp.

1–4. KYLLINGA PAUCIFLORA.
5–9. SCHOENUS ERINACEUS. 10–14. ASCOLEPIS PUSILLA.

R. Morgan ad nat. lith. West, Newman & Co. imp.

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[VOL. II. PART 8.

THE TRANSACTIONS OF THE LINNEAN SOCIETY OF LONDON.

STRUCTURE AND DEVELOPMENT OF THE GYNOSTEGIUM,

AND ON THE

MODE OF FERTILIZATION IN ASCLEPIAS CORNUTI, DECAISNE
(*A. SYRIACA*, LINN.)

BY

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IX. *On the Structure and Development of the Gynostegium, and the Mode of Fertilization in* Asclepias Cornuti, *Decaisne* (A. syriaca, *L.*). *By* Thos. H. Corry, *M.A., F.L.S., M.R.I.A., late Assist.-Curator, University Herbarium, Cambridge.*

(Plates XXIV–XXVI.)

Read 7th June, 1883.

I. Development.

The structure and mode of fertilization of the flowers in the genus *Asclepias* and, indeed, in the natural order Asclepiadeæ in general, have proved somewhat of a botanical enigma, although they have received the attention of botanists of greater or less repute, and have formed the object of numerous and varied speculations and researches ever since the days of Dillenius. The mode in which the parts of the flower are developed from their earliest stages until they attain the adult condition did not, however, engage attention until a much later date, the first person to draw attention to it being the celebrated English botanist, Robert Brown *. J. B. Payer, in the course of studies for his 'Traité d'Organogénie Comparée de la Fleur,' which appeared in 1857, pp. 567–570, pl. 117, also made the flower of *Asclepias* the subject of his investigation. These two writers between them left, as might naturally be expected, not a great deal to be done by those who came after, and a few of the points they did not settle were, partially at least, set at rest by the researches of Hermann Schacht †.

The mode in which the corpuscula and their appendages are formed had, however, never been worked out; and as the conclusions arrived at by these writers on several other very important points were somewhat at variance, I was led to make a further and much more extended examination of this portion of the subject. In treating of this I will, however, confine myself *solely to those points in which my work has afforded me results either new or different from those which are most generally accepted at the present time.*

I have devoted my attention mainly to the flowers of *Asclepias Cornuti*, Dec., but have also referred to other species and genera.

The type of the flower essentially agrees with that which is fundamental in the other orders of the group Bicarpellatæ of Bentham and Hooker, and is represented typically by the formula $K_{(5)}\ C_{(5)}\ An_5\ G^2$. It is actinomorphic, the pentamerous symmetry being only broken in the carpels, and most nearly approaches that of the Apocynaceæ. The two ovarian parts of the carpels in their growth never become connate with each other, as is the case in the majority of the natural orders forming the group Bicarpellatæ, *e. g.*

* "On the Asclepiadeæ," Memoirs of the Wernerian Natural-History Society, Edinburgh, vol. i. 1808–1810, pp. 12–58 (read 1809); "On the Natural Order of Plants called Proteaceæ by Jussieu," Trans. Linn. Soc. 1809, vol. x. pp. 18, 19; Misc. Bot. Works, vol. i.

† 'Das Mikroskop,' ii. Aufl. p. 166 *et seq.* pl. 5, English edition, 1853, by F. Currey, pp. 100–108. figs. 5–27.

Solanaceæ, Labiatæ, Scrophularineæ, Borragineæ, &c., but each is isolated, and forms a distinct ovary surmounted for some distance by a distinct style. The growth of the carpellary leaves is basifugal, and in consequence the apices of their styles are the last parts to be formed. These latter are never incurved, as is the case with the rest of the carpels; they are at first quite distinct from one another, but soon begin to become thickened and fleshy, and then exhibit a more or less rounded or club-shaped form. Each contains a single fibro-vascular bundle. The growth of the pistil is also accompanied by that of the other floral whorls, and the stamens and corolla press closely upon the sides of the gynæceum; thus it comes to pass that the carpels become more closely pressed together, especially in their stylar parts. These still remain distinct below, but their apices, which are in a meristematic condition, become first applied together by their internal faces, and then so intimately fused by these same parts that all sign of sutural union between them disappears; for at a somewhat later epoch no trace of the former line of demarcation can be defined in the now homogeneous tissue. The two fibro-vascular bundles, which at first pursued a straight course upwards through the styles to their apices, are now found to have undergone a curvature inwards at the point where the upper parts of the styles which still remain distinct pass into the combined apical portions, so that the vertical parts of the bundles in the lower parts of the styles are now exterior to those in the fused upper parts. The combined apices form a single body common to the two ovaries containing two closely approximated fibro-vascular bundles. This body grows out rapidly, especially in the intervals between the anthers, forming a thick, fleshy, pentagonal table-shaped disk, which may be termed the *style-table*, and which is depressed above so as to appear truncate. The angles of its margin alternate with the stamens. It completely hides the lower free parts of the two styles in a downward view. The question of the morphological nature of the style-table in *Asclepias* is of some considerable interest in connexion with the morphology of the gynæceum generally. The view which I have adopted is directly opposed to that which is most usually received, and is supported, so far as I am aware, only by the great authority of Lindley * and Eichler. The generally accepted opinion is that first put forward by Nicolas Joseph Jacquin †, and since supported by such eminent observers as Robert Brown, Payer, Schacht, and likewise many others ‡. These regard the common disk-shaped mass as formed by the fusion or lateral union, not of two style-apices, but of two terminal stigmas, the styles proper remaining distinct throughout their whole extent. If the view of Jacquin and his followers, that its nature is stigmatic, be true, we are presented with the curious anomaly of the prolongation of fibro-vascular bundles into the substance of a tissue whose main object is to be receptive and secretory, but which is only so over a very limited area; and it is clear that since the pentagonal disk-shaped mass formed by the fusion of the upper parts of the styles in Apocynaceæ possesses the same peculiarity and

* 'An Introduction to Botany,' 4th edition, 1848, vol. ii. pp. 223, 224.

† 'Miscellanea Austriaca ad Botanicam, Chemiam, et Historiam Naturalem spectantia,' vol. i. sect. i., "Genitalia Asclepiadearum," pp. 1–31, plates 1–4, also "Genitalia Asclepiadearum controversa," Viennæ, 1811.

‡ J. Sachs, in the 2nd English edition of his 'Text-Book of Botany,' 1882, adopts the same view, pp. 222 and 569.

situation, it ought always to be regarded as stigma, and not style; and such, indeed, Payer (*loc. cit.*) believed it to be. More recent observers, however, declare that the disk of Apocynaceæ is stylar, while they still regard that of the Asclepiads as stigmatic. If we confine and restrict the term stigma to "that part of the style which is destined for the reception of the pollen," and is in consequence specially modified for this function, many of the difficulties would vanish completely. The Asclepiadeæ form only one among many cases where the employment of this identical term "stigma," in a wider, but at the same time in an erroneous sense, has led to much confusion. Adopting then the definition which has been advanced, it is evident that the disk of Apocynaceæ and of Asclepiads is of the same nature, viz. *stylar*.

The receptive surface of *Asclepias* is not confined, as Eichler* thinks, to five linear lines or bands, but covers the entire inferior surface, though it is only exposed to the exterior at five points, because in these situations it can alone be effective. The number, five, is, however, determined by the surrounding parts of the flower.

I have used Haworth's term, *style-table*, to indicate this table-shaped mass formed by the united style-apices, inasmuch as it bears the stigma, or specially receptive tissue, on its lower surface in *Asclepias*, and also because the term is a convenient one to employ in description.

Owing to the fact that the two carpels lie antero-posteriorly opposite each other, and that the incurving of the edges in each takes place towards the central axis of the flower—the parts being, while this is in progress, pressed closely together, and involution of the extreme edges of the carpels taking place, so that they turn completely inwards, before the sides meet—a small space is left between the two ovaries. This space was part of the original elliptic space enclosed by the two primitive carpellary outgrowths. If a transverse section be taken in the region of the base of the two styles, this space appears somewhat diamond-shaped, while in a similar section, taken higher up at the extreme apices of the styles (*i. e.* where they meet the style-table) in which place the carpellary leaves are less perfectly incurved, it has the form of a narrow ellipse. This space has been dignified by Schacht, Schleiden†, and others with the title of "the canal of the style;" but it has no functional importance whatever, its occurrence being purely accidental, and it is not in any way homologous with "the canal of the style" which is described as existing in *Primula* and certain other plants. At the stage when the complete union of the apices of the styles has just been effected, a transverse section through the style-table, about its middle, shows between the two fibro-vascular bundles a small diamond-shaped hole, which, when traced downwards in successive sections, is found to be the last remnant of this so-called "canal of the style," still indicative, like the two fibro-vascular bundles themselves, of the original composition of the pentagonal disk-shaped mass. In the subsequent stages the walls of that portion of the so-called "canal of the style" which exists in the style-table gradually approach each other and completely obliterate the

* 'Bluthen Diagramme,' 1875, vol. i. pp. 523–529.

† Dr. J. M. Schleiden, 'Grundzüge,' 2nd edition, also 'Principles of Scientific Botany,' ed. 3, translated by E. Lankester, 1849, pp. 356, 359, 377, 379–382, fig. 220.

lumen, so that no trace of it whatever remains which can be detected on section. Schleiden (*loc. cit.* p. 380, note), however, states that in *Stapelia* two point-like excavations are frequently seen on the upper surface of the style-table, which are traces of this confluent "canal." Sprengel (*loc. cit.*) observed a somewhat similar appearance in *Gomphocarpus fruticosus*, R. Br. (*Asclepias fruticosa*, L.); for he describes the existence of a slight slit in the centre of the upper surface of the style-table in that species, and he found, on passing a knife down it, that it ended inferiorly between the lower parts of the two styles and the two ovaries. Jacquin ('Genitalia,' pl. 2. fig. 2) also figures in *Asclepias curassavica*, L., a central median line in the apex of the style-table, which is evidently only another trace of the formerly existent "canal." Each anther occupies a position corresponding to one of the flat or, rather, concave surfaces of the pentagonal style-table. The lateral marginal borders of the anther, which are beyond the anther-cells and touch the angles of the style-table, become thin, membranous, and hyaline, forming broad, rigid, cartilaginous flaps, which are often bent sharply outwards and backwards so as to project strongly, nearly at a right angle, from the rest of the anther, and at fully a right angle from the column formed by the staminal filaments. In shape each flap is more or less triangular, narrowing to a point above, while its base is acute; and here it turns slightly upwards, so that the broadest portion is just a little above the base. These flaps have been called the "anther wings," or "*anther alæ*," and are believed by some botanists to be expansions of the base of the connective or else of the filament to which the anther is affixed. In my opinion they are expansions of the sides of the connective.

I will now give, as briefly as possible, the results I have arrived at with regard to the mode of development of the corpuscula and their appendages.

Immediately before the period of union between the stamens and the style-table a shallow longitudinal furrow, at first extremely faint, may be observed along the middle of each of the five prominent angles of the style-table. This groove is somewhat wide at its lower end, but narrows slightly towards the apex of the table, and dies away abruptly where the top of the pentagonal mass forms a rounded projecting eave. These five grooves, therefore, alternate with the anthers and nectaries (which latter have not yet appeared), and are opposite the corolla lobes. The sides and floor of each of them are lined by the moderately thick uncuticularized columnar epidermis which covers the surface of the style-table; but in the region of the groove the cells are elongated perpendicular to the surface, and slightly rounded at their free ends. The epidermis, therefore, in this region has a remarkably sharp and distinct definition. The upper portion of the groove soon becomes both deeper and wider for a short distance; and this is owing to the cells which line it and form its sides becoming, for a comparatively limited area, very long, thin, and papilliform, with rounded projecting ends, presenting a villous appearance in surface view.

These papilliform cells are actively excretory, and they exude a gummy adhesive matter, which occupies the intervals between the projecting ends of the papilliform cell, which, as it dries, forms a sheet and becomes hardened externally. So great, however, is the amount of successive additional secretions that the gum speedily covers even their free ends, forming a flat membrane, into the lower part of which the cells fit, while the portions which were first excreted become carried successively more and more to the exterior of the mass. As the gum dries it becomes darker, and changes from colourless to a light golden-yellow, then to dull brownish yellow, and finally to dark black or reddish brown. It is never at any period green, as it is stated to be at first by Schleiden *. It likewise becomes very hard, and assumes almost the consistence of horn or cartilage; but its original structure is still to be seen in transverse section, especially in the part in contact with the excreting cells, which is still viscid and semifluid. The excretion of this gum appears to take place first from the cells forming the sides of the furrow, and only at a later period from those forming the floor; and as the liquid gum is exuded it flows down towards the base of the furrow, so that, soon after the membrane stage, two slender, parallel, partially hardened, masses of gum, more or less resembling quadrants, and of a light-brown colour, are found lying in the groove. They are still, however, quite distinct from each other, being separated by the cells forming the median floor of the groove, which have not yet begun to excrete (fig. 14). As the growth of the style-table proceeds, the two masses of partially hardened yellow gum which lay at the base of the furrow side by side with the angles of the quadrants, directed laterally *in the previous stage*, have been carried upwards, and are now to be found adhering laterally to the cells, which at this period form the mouth of the furrow, but which were originally situated near its floor (fig. 15). In this process the angle of each quadrant has been rotated through an angle of 45°, so that now the masses of gum project and partially roof over the open mouth of the groove. Excretion then takes place from all the cells forming the sides of the furrow, and so, by successive additions from behind, the quadrant-shaped masses are more closely approximated, while at the same time the sides of the future corpusculum are formed. The cells forming the floor now begin to excrete, so that the two masses of hardened gum become joined together posteriorly by less hard material, which is therefore of a lighter colour. This junction takes place first at their upper extremities where the groove is narrowest across, and gradually proceeds backwards, the two hardened masses being in consequence first united above posteriorly and lying close together but still ununited for the rest of their length, and then afterwards united posteriorly along their whole length, but so delicately at this time that the mass tears into two parts posteriorly when its removal from the furrow is attempted.

The cells forming the extreme borders of the furrow likewise excrete, and their liquid excretion, flowing down and hardening, augments the thickness of the corpusculum above on its antero-lateral angles.

This hardened mass of gum, the *apparently* cellular structure of which is caused by the impression of the underlying cells which excreted it, and to which it was at first adherent (for it is really formed of pseudomorphs of cells †), has been dignified by Jussieu, Robert Brown, Payer, and others as a "gland," and by others again as a "stigmatic

* 'Grundzüge,' English translation, p. 382.

† Compare the retinacula of the Orchids, which, according to the researches of the younger Reichenbach, 'De Pollinis Orchidacearum Genesi ac Structura,' Leipsic, 1852, are formed of true cells, which are metamorphosed and secrete a fluid, and are therefore of a glandular nature, though they serve a somewhat analogous function to these masses of gum in *Asclepias*.

corpusculum or tuberculum." Of these designations, the simple name "corpusculum" is infinitely the more preferable, since the former conveys a totally erroneous idea as to the real nature of the body; for it is not a gland which secretes at all, but a true excretion.

From the mode of formation of the corpusculum, then, it may be gathered that it encloses a hollow or cavity, which is narrower above, where, owing to the overlapping of the rounded eave of the style-table, the sides of the furrow which formed it meet the floor; that it is further closed posteriorly, but open anteriorly, for in the latter part the masses of gum lying at the mouth of the furrow project, *i. e.* are bent forwards and inwards over the longitudinal hollow, while at the same time they oppose each other and are approximated closely together. They converge more above than below, owing to the shape of the furrow which excreted them, so that the deep longitudinal fissure which is left between them (for they never meet) is wedgeshaped. In consequence of the existence of this fissure, which is widest inferiorly, narrowing above, the whole corpusculum appears, when viewed *in situ* from the front, to be imperfectly cleft or divided in a symmetrical manner into two halves or valves. The slightly curved projecting margins or edges, which were first formed, and hence have dried more than the rest and become harder, do not end superiorly by uniting, but are distinct for their whole length; as, indeed, is a matter of necessity owing to their mode of formation. Finally, the lumen of the corpusculum is completely open inferiorly, where the wider deeper excreting portion of the original furrow becomes continuous with the narrower non-excreting part (*vide* figs. 14, 15, 19). By degrees the hardened mass of gum becomes more solid, and is easily separable as a single mass from the furrow; it exhibits no longer any indication of a suture, or of having originally consisted of two distinct parts, and is loosened from the cells which excreted it. It may then be found no longer, as heretofore, closely lining the furrow, but lying on the contrary somewhat loosely at its mouth, while the epidermis, which excreted it, is quite uninjured and continues uniformly to line the furrow just as before. The whole corpusculum has now dried so completely that only a striated appearance in transverse section remains to indicate its original origin. It forms a thin hard firm body with a shining surface, of a cartilaginous or horny texture when cut, and of a dark black or reddish brown colour. Its uniform nature is seen by treating a thin transverse section with a strong solution of caustic potash. The results of my researches as to the origin and development of the corpusculum are directly opposed to the view of Schleiden (*loc. cit.* p. 382), who, from some observations on *Gomphocarpus*, R. Br., and *Hoya*, R. Br., thought that probably the outermost borders of the anther-wings are formed rudimentarily very early at the five upper ends of the stigmatic furrows, so that each body (corpusculum) originates from the cohesion of two fragments of two different anthers, though he admits that the point is one of the most difficult to investigate that he knew of. The younger Reichenbach also remarks, concerning this view, that in *Dictyanthus*, Decaisne, the lateral processes of the anthers do not touch the angles of the style-table, so that in this genus at least the corpuscula could not be so formed.

My results, however, completely confirm and more fully carry out the imperfect and fragmentary observations of Schacht and the younger Reichenbach as to the mode of origin and nature of these bodies. Robert Brown, who was the first observer to investigate them, seems also to have arrived at the true fundamental idea as to the method of their formation, viz. by secretion or excretion from the cells lining the furrows, though he unfortunately employs the term "glands of the stigma" to designate them when fully formed, and so his description of them, fairly good in many respects,* is misleading. Payer believed that the corpusculum was really a secretory gland, whose secretion gave rise to the corpuscular appendages, an idea which is thoroughly erroneous. No one appears to have ascertained, previous to the present investigation, how the superior boundary of the corpusculum was formed, or most of the other details of the foregoing account.

While the corpusculum is being developed in the manner above detailed, certain other changes have also been taking place. At the period when the corpusculum has the form of two separate elongated masses of partially hardened gum, the epidermal cells of the style-table become papilliform along the region of two lines, which diverge laterally from the sides of the wider and deeper excreting portion of each furrow a little below its middle at an acute angle and have a downward oblique direction (fig. 16). The effect of this is to cause the excreting part of the furrow to broaden somewhat at the point of divergence of the lines, and from ovate-oblong to become more or less rhomboidal in shape. This change in shape on the part of the furrow naturally determines the external form of the corpusculum to a certain extent, for when mature it has a form between ovate-oblong and rhomboid. The epidermal cells, which become papilliform in the region of the two lines, do not all extend to a uniform length, but some are longer than the rest, so that along each line a shallow groove, *i. e.* a more superficial depression than the main furrow, is produced, which later is lined by papilliform cells and bounded by a series of cells forming longer papillæ, these last in turn gradually fading off laterally on either side into the ordinary epidermis of the style-table. The cells of these diverging grooves (which grooves are in some cases extremely short, but in the species *A. Cornuti* of considerable length, so as to be at least three times the length of that part of the main furrow which excretes the corpusculum) exude, like the main groove, a viscid matter. This occupies the intervals between the projecting rounded free ends of the papillæ, just as in the case of the formation of the corpusculum; and the excretion appears, in this case, to begin simultaneously from *all* the cells which line the narrow furrow. The degree of hardening which the gum attains is never so great as in that of the corpusculum, owing in part to the comparatively late period of development of these diverging furrows as compared with that of the main furrow, and also partly to their being, even when the flower expands, carefully protected from exposure to the air by the anthers and anther-alæ, which closely overlie them. The amount of successive exudation, from the cells lining each of the narrow furrows, then, is only sufficient to cause the formation of a single compact solid mass of partially hardened gum, which for some time previous is in a semifluid condition, but when completed is wedge-shaped when cut transversely, and has a slight yellow colour or is brownish in its thickest part. Into the inferior surface of this mass the ends of the excreting cells still project, and on the broad margins of the furrow outside the edges, where the epidermal cells are still somewhat papilliform,

* Memoirs of the Wernerian Natural History Society, vol. i. 1808–1810, pp. 12–15, Edinburgh, and Misc. Bot. Works, vol. ii. pp. 195–199.

excretion now takes place, and the amount of gummy matter exuded is only just enough to give rise to a sheet of gum occupying the intervals between the rounded ends of the papilliform cells, which still project through, it being covered only very slightly if at all with gum (figs. 16, 17, 18). When therefore the partially hardened, somewhat elastic, and still very viscid excretion of one of these diverging grooves is forcibly removed, its broad edges or margins are seen, when examined under the microscope, to have the appearance of a flat perforated membrane, which is exceedingly viscid, the perforations in which correspond to the position of the excreting cells (fig. 16). The two diverging furrows, each with its excretion of partially hardened gum, arise perfectly independently of the main furrow, and their excretions are for a very short time unconnected with the corpusculum, but afterwards they become attached to this body. These excretions are then known as the "processes, arms, caudicles, or appendages" of the so-called "gland," which was formerly regarded, *e.g.* by Payer, as giving rise to them in the form of a secretion, which travelled downwards in the diverging furrows, but which, as has just been shown, does not do so. The term "corpuscular processes," or more preferably "appendages," may be conveniently applied to them. Robert Brown recognized the independence of their origin from that of the corpusculum, and Hermann Schacht the fact that they are produced by a method generally comparable to that in which the corpusculum itself is formed; it will be evident, however, from the foregoing account, that the actual details are somewhat different. If at this period the corpusculum is separated from its furrow, these appendages will remain firmly attached to it, and come away with it in the form of flat compressed membranous sheets, each with a central darker, more thickened, solid portion (*vide* figs. 16, 19). The upper extremity of each of these slender elongated corpuscular appendages impinges or abuts laterally (fig. 16), as has been already stated, on the corpusculum seated in the corpuscular furrow, while the lower diverging extremity lies directly over the apex of one of the anther-cells. Since the furrow in which the corpusculum is formed is always placed in the interval between two stamens, it follows that the two anther-cells, on the apices of which the appendages of the same corpusculum abut, do not belong to one and the same stamen, but to two different though neighbouring stamens.

At this period of the developmental history, however, the contents of each ovoid anther-cell are quite free and distinct from the corpuscular appendage; for the anther-cells are completely closed, and it is quite possible to remove the corpusculum and its appendages without displacing anything else. The free unconnected extremities of the appendages, though still very viscid, are not thickened to any extent; while the contents of each anther-cell have at this period acquired the colour, form, and degree of solidity characteristic of them in the mature state; and it is possible easily to separate them from the anther-cell in a single mass, forming a pollinium.

The triangular anther-alæ stand in such a manner as only to leave a very narrow longitudinal linear slit or chink between them, which may be termed *the alar fissure* (*a. f.*, figs. 5, 6). This fissure lies directly over one of the furrows which occur at each angle of the style-table, and in the upper part of which the corpuscula are formed. The result is that, between the outer margins of the alæ on the one hand, and the surface of the style-table on the other, a chamber is formed. This chamber, which will henceforth be spoken of as the "alar chamber," has, when seen in transverse section taken in the region of the style-table, a somewhat pentagonal boundary (fig. 11), the base of the pentagon being formed by the groove on the style-table, which is lined by papillar epidermal cells, the sides by the lateral processes of the anthers (*a.s*, fig. 12), which, fusing with the style-table, effect the gynandrous union, while the opposite angle is constituted by the two anther-alæ, which, though nearly parallel externally, diverge somewhat on their inner surface. The lower or more basal half of the alar chamber is rendered more spacious than the higher by the circumstance that in this region the lateral sides of the style-table themselves terminate by bending towards the axis to form the inferior or lower surface of the table. The inferior edge of the table, in the five intervals which separate the anthers, rests closely upon the upper edge of the continuous fleshy column which is formed by the connate filaments of the 5 stamens.

In a transverse section taken just below the point where the inferior ends of the contiguous anther-alæ arise and begin to diverge from the anthers, leaving between them the narrow alar fissure, the column formed by the filaments is found to exhibit, in a position corresponding to the interval between 2 anthers, a narrow ellipsoid space (*el*, fig. 9). This space, I believe, indicates that at this point the connate union which has taken place between the two adjacent anther-filaments is not in this region perfectly complete. It is enclosed on all sides by the tissue of the column.

In a similar section, taken immediately above that last described, the external end of the ellipsoid space is continuous laterally with two grooves (*gr*, fig. 10, in a higher section), which run obliquely inwards to meet it.

Proceeding still from below upwards, in a third section the external wall of the space is divided by a fissure passing through its middle, and the ellipsoid space is converted into a narrow open channel, while the remnants of the external wall form two minute light-green fleshy teeth. These teeth embrace between them the bases of a pair of anther-alæ (*m, m*, fig. 10). Their function will be considered hereafter.

Immediately above this, the tissue forming the two angles where the lateral oblique grooves join the ellipsoid space, increases in bulk. This takes place at first slightly, but as we proceed upwards it becomes very rapidly more marked, the tabular cells, which in the lower sections formed the angles, being borne at the ends of long processes of ordinary parenchymatous ground-tissue, with elongated cells, which processes are at first converging and then subparallel. The remains of the ellipsoid space (*el*, fig. 10), together with the open channel between the alæ, form in this region, then, the prolonged lower end of the alar chamber, which in transverse section appears bounded by the anther-alæ externally, but laterally and posteriorly by the original wall of the ellipsoid space. Rather above the middle of the alæ the cells forming the lateral walls of the alar chamber become directly continuous at the internal end with the cells forming the internal vertical wall of the staminal column *, leaving the chamber for a very short vertical height open posteriorly as well as anteriorly. This

* The internal vertical wall corresponds to the upper surface of the petiole in an ordinary foliage-leaf, as is well seen by the relations of the fibro-vascular bundles in the filaments to their internal and external surfaces respectively.

appearance, if it occurred only in a single section, would indicate merely the upper termination of the staminal column in this region; but, since it occurs in several sections succeeding one another, it shows somewhat more than this. For in the median line of the alar furrow, in consequence of the mode in which the upper extremity of the staminal column terminates superiorly on either side, a very shallow notch is found to be left in the column when, after the partial removal of the alæ by section, it is looked at from the front. This notch is opposite to the completely open canal of the alar chamber. Viewed from above for its whole length, it forms a very short and shallow radial furrow (*r*, fig. 11). The style-table is found, on examination, to be closely applied by the whole circumference of its base to the superior edge of the staminal column formed by the 5 united filaments, except at 5 points. Each of these points corresponds in position to one of the 5 alar fissures, and is due to the presence of one of the short radial furrows, formed in the manner just described. The appearance presented by the upper ends of the cells forming the side of the short radial furrow was accurately figured by Adolphe Brongniart *, although both he and Robert Brown seem to have been altogether ignorant of the existence of the five radial furrows themselves, which I may remark, in passing, it requires very careful examination and manipulation to show clearly, especially in longitudinal sections. At the 5 points above mentioned, which are directly opposite the 5 alar fissures, a slight means of communication exists between the parts which are enclosed in the interior of the staminal tube and the exterior of the flower (*m*, fig. 13), the object of which will be considered at length hereafter. Schleiden alone seems to have had some idea of the 5 furrows, though his account is vague. He remarks that "immediately below the 5 (alar) grooves 5 points remain without acquiring a perfect epidermis beneath, while 5 cords of conducting tissue are formed from these 5 points into the canals of the 2 styles" †. His "5 points" evidently refer to the external beginnings of the conducting tissue (*stig.*, fig. 11; *e*, fig. 13).

The form of each of the pollinia is more or less obovate. The pollinium is further flattened and compressed, appearing elliptical in transverse section, but with one edge slightly more convex than the other (*pol.*, fig. 19).

The contents of the anther-cells being fully mature, each of them, immediately prior to the expansion of the flower, opens internally. This is effected by almost the whole of the thin-walled parenchymatous tissue which forms the substance of the anther, together with the remains of the two tapetal membranes, becoming broken down. The change also affects the upper portion of the epidermis on the internal side of the anther, which is never cuticularized. The disintegration appears to take place from above downwards, commencing first at the apex of each of the cells, and gradually proceeding downwards. The apices of the pollinia are thus exposed first, and on their internal side. Immediately on its exposure the apex comes into contact with the lower or inferior free ends of one of the corpuscular appendages, which is still in a semiliquid condition, and extends slightly beyond its furrow. The viscid end of the appendage flattens itself

* "Quelques Observations sur la manière dont s'opère la fécondation dans les Asclépiadées," Ann. des Sc. Nat. vol. xxiv. 1831, pl. xiv. fig. 5.

† 'Principles of Scientific Botany,' ed. iii. 1849, pp. 381, 382.

against the external covering of the side of the attenuated end of the pollinium, immediately below its apex, forming a slightly expanded adhesive surface, and so the two parts become firmly attached to each other (fig. 19). The pollinium being thus firmly held from above, the rest of the parenchymatous tissue disintegrates, an internal wall several layers thick, and in the lower two thirds of each cell an internal wall also, persisting. The pollinia are thus left hanging freely suspended in the 2 open cavities of the anther, and in no way adherent to it, the pair being separated only by the median dissepiment. This latter persists. The pairs of contiguous pollinia belonging to adjacent anthers are, by the intervention of the corpuscular appendages and their corpuscula, attached to the upper part of the style-table below its margin. It is then possible, by inserting a fine needle between the contiguous anther-alæ near the base of the alar fissure, and carrying it upwards along the line of the fissure, to lift away the corpusculum with its appendages and the two pollinia which are attached to them (fig. 19).

Jacquin *, who examined the anthers only in their adult condition, when they had already dehisced, naturally regarded the anthers in which the pollinia lay freely immersed as "antheriferous sacs," and the pollinia themselves as the true anthers: in this he was followed by Kölreuter †, Rottboell ‡, and a host of others; and when Schreber §, in 1789, insisted that these sacs of Jacquin were really anthers, he was instantly denounced by an indignant host of authorities, although his view as to the true nature of these parts has been since most amply confirmed and borne out.

It is an important feature that in the anther of *Asclepias* no special provision which shall determine its dehiscence exists, such as takes place in other plants by the reticulate thickening of the walls in a layer of cells immediately internal to the epidermis, *i. e.* the so-called "endothecium" of Purkinje ‖. Schleiden ¶ states that the inner wall of the anther is torn away from the connective in the median line, and "that the wall of the cells which thus becomes disengaged is dry and elastic, and is termed the valve (valvula)." This observation is certainly inaccurate; for in every case dehiscence of the anther occurs solely by absorption of the tissue, and not by any portion becoming disengaged.

The nearest instance which I have been able at present to discover to this type exhibited by *Asclepias* occurs in a case described by Hofmeister, where the anther-lobes open at the apex by a pore which results from the destruction of a small portion of tissue at this spot; but, in all probability, other instances of the same phenomenon will not be wanting when a more extensive and exact knowledge is attained of the various modes in which the dehiscence of anthers can take place.

II. Mode of Fertilization.

1. *POLLINATION.*

A. *Historical Sketch.*

That the Asclepiadeæ are pollinated by the agency of insects has long been known.

* 'Selectæ Stirpes Americanæ,' 1763, p. 82.

† 'Anthera Contortum.' Actorum Academiæ electoralis Theodoro-Palatinæ V. vol. iii. Physic., 1775, pp. 41 *et seq.*

‡ 'Botanikens udstrakte Nytte,' pp. 27 *et seq.*

§ 'Genera Plantarum,' pp. 166 *et seq.*

‖ 'De Cellulis Antherarum fibrosis.'

¶ *Loc. cit.* p. 359.

It was conjectured by Count W. F. Gleichen *, even so far back as the year 1779, although his description of the floral mechanism by which it takes place is in most points far from accurate, and he himself never observed the actual *modus operandi*. Notwithstanding the fact that he observed the pollinia attached to the lower ends of the lateral angles of the style-table, *i. e.* in the place where Brown afterwards found them, and producing each a cord of pollen-tubes which passed from thence to the apices of the styles, he does not seem ever to have known exactly the precise value of his own observations; for he considered that if the plants are ever fertilized by the agency of insects (though in what way he does not state, and the extraction of the pollinia by them was quite unknown to him), it is the exception rather than the rule.

Christian Konrad Sprengel, in his classic work 'Das entdeckte Geheimniss der Natur im Bau und in der Befruchtung der Blumen,' published in 1793 †, was the first to observe the method by which the pollinia are extracted by insects in *Gomphocarpus fruticosus*, R. Br. (*Asclepias fruticosa*, L.). These visit the flowers for the sake of the nectar secreted by the corona. His account of this preliminary step in the process of pollination is in many respects admirable. But though Sprengel observed with accuracy, it happened, unfortunately for science, that a false and erroneous hypothesis lay at the basis of nearly all his work, since he imagined that self-fertilization and not cross fertilization was the rule; and it was on this account that he failed to realize the full value and use of the marvellously adapted mechanism which exists in these flowers. He believed that the pollinia, when withdrawn through this agency, were applied by the insect creeping over the flower to the upper slightly concave surface of the great style-table of that same flower from which they had been taken, the insect being intoxicated by the nectar in order to endow it with an extraordinary amount of activity, which he regarded as necessary, or at least advantageous, to the act of pollination. Of the real manner in which fecundation is accomplished, and of the proper stigmatic surface, he was entirely ignorant, and, moreover, he had also erroneous ideas as to the mode of action and structure of the corpusculum; for, following Kölreuter, he imagined that it behaved after the fashion of a trap. But though such was Sprengel's view of the matter in regard to *Asclepias* and other plants in general, he seems to have had glimpses occasionally of the true state of matters; for on p. 43 of his work just quoted the following very remarkable and pregnant statement occurs:—"Since a large number of flowers are diclinous, and probably at least as many hermaphrodite flowers are dichogamous, Nature appears to have designed that no flower shall be fertilized by its own pollen."

In 1831 Robert Brown ‡ added several of the most important links to the chain of our

* 'Auserlesene mikroskopische Entdeckungen bei den Pflanzen, Blumen, und Blüten, Insekten und andern Merkwürdigkeiten,' Nürnberg, 1777–1781, pp. 73 *et seq.*; also translation into French by J. F. Isenflamm, Nürnberg, 1790.

† Pp. 139–146, plate ix., figs. 4, 5, 10, 11, 38–41.

‡ 'Observations on the Organs and Mode of Fecundation in Orchideæ and Asclepiadeæ,' printed for private distribution, Oct. 1831; Trans. Linn. Soc. vol. xvi. pp. 685–745, 1833, plates 34–36; and Misc. Bot. Works, vol. i. pp. 487–536, plates 30, 31, 32. Abstract of last, Philos. Mag. and Annals of Philosophy, Dec. 1831; also Edinburgh Jour. of Sci. vol. vi. pp. 174–183, 1832; also Flora, xv. pp. 353–366, 378–382, 673–676. 'Additional Observations on the Mode of Fecundation in Orchideæ' read June 1832, printed with the last in Trans. Linn. Soc. vol. xvi. and Misc. Bot. Works, vol. i. pp. 537–543. 'Supplementary Observations on the Fecundation of Orchideæ and Asclepiadeæ,' printed privately, London, 1833; and Misc. Bot. Works, vol. i. pp. 545–551; also (in French) Guillemin's Archiv. Bot. vol. ii. pp. 324–329, 1833; and (in German) Flora, vol. xvii. pp. 17–24 (1834).

knowledge of the mode in which the fertilization of the Asclepiad flowers is effected. In the blossoms of seven species of the genus *Asclepias* which he examined, he several times detected the fact that one of the pollinia was removed from the anther-cell, and remained no longer fixed by the descending "process" to the stigmatic corpusculum, but was immersed, and hidden from external view, in one of the fissures between the projecting anther-alæ, while in most cases it was separated from the stigmatic corpusculum to which, when *in situ*, it had been attached. He further observed a connexion between the gibbous part of the more convex edge of the pollinium (which, when the pollinium lies *in situ* in the anther-cell, is placed on the side furthest from the alar fissure) and that point where the apex of the tube formed by the combined staminal filaments *is joined* * to the surface of the base of that angle of the style-table which corresponds to it. This point is in close contact with the pollinium. The connexion alluded to is produced by the rupture of the pollinium and the production of a great number of delicate pollen-tubes, which, forming a fasciculus, pursue a course which runs, in a manner hereafter more fully described, directly inwards along the base of the style-table to the apices of the styles. From this it will be gathered that Brown had found the truly stigmatic portions of the table. Aware, as he was, of Sprengel's observations on the mode of extraction of the pollinia by insects (since he refers to the portion of the latter's work in which they are contained), Brown evidently believed:—

1. That the pollinia must be extracted by means of an insect; and

2. That, when so extracted by this agent, they were applied by it to a distant part of the same or a different flower †, and were no doubt brought by means of insects, the assistance of which he regards as "absolutely necessary" ‡ to the position in which he afterwards found them, viz. within the alar chamber and in contact with the base of the style-table §, where the truly stigmatic portion lies.

Since he further remarks that "the prevailing form of inflorescence in Asclepiadeæ is well adapted to this economy [of pollination], for the insect so readily passes from one corolla to another that it not unfrequently visits every flower of the umbel" ‖, we may infer that he believed that these flowers were usually not self- but cross fertilized.

Brown, however, seems to have been ignorant of the movements which the pollinia undergo after their extraction, or, if he was aware of their existence, to have attached no value to them. Nor did he understand the precise method in which pollination was accomplished by the insect, and he does not mention having ever directly observed the process.

The actual extraction of the pollinia by the feet of insects, and their subsequent insertion by the same agency into the fissures of the alar chambers, was for the first time observed by Frederico Delpino, in 1865, in the flowers of *Araujia albens*, G. Don ¶. This observer drew attention to the circumstance that identically the same mechanical con-

* This is Brown's expression. As to its strict accuracy, *vide* hereafter, on p. 201.

† *Vide* note on p. 522, Misc. Bot. Works, vol. i. ‡ *Ibid.* vol. i. p. 542.

§ "Style" in Misc. Bot. Works, vol. i. p. 527: obviously a misprint. ‖ Misc. Bot. Works, vol. i. p. 717, note.

¶ 'Relazione sull' apparecchio della fecondazione nelle Asclepiadee,' &c., Torino, 1865. 'Sugli apparecchi della fecondazione nelle piante antocarpee,' Firenze, 1867, especially pp. 6–15. 'Sull' opera La distribuzione dei sessi nelle piante e la legge che osta alla perennità della fecondazione consanguinea, del Prof. F. Hildebrand,' Milano, 1867: especially pp. 24–25. 'Ulteriori osservazioni sulla dicogamia nel regno vegetale,' Milano, 1868–1869, especially pp. 224–228 & 243 (*Ceropegia elegans*). Also in 'Atti della Società Italiana di Scienze Naturali in Milano,' vols. xi. & xii.

trivances ingeniously served a double purpose, *i. e.* both for the process of extraction of the pollinia and for their insertion.

This process was in the following year described independently by Prof. Friedric Hildebrand * in *Asclepias*, and in the spring of 1867 for this and other genera of the order as well by Delpino. Hildebrand supplemented his translation of Delpino's paper last mentioned, which he published in German in the autumn of the year in which the original appeared, with notes of some further observations of his own, and in particular with an account of the very remarkable movements which the pollinia undergo between the period of their extraction and that of their subsequent insertion into the fissure of an alar chamber. These movements he was the first to observe and draw attention to.

The amount of labour independently bestowed by these last two observers upon the whole subject of the pollination of these flowers, and the value of the results at which they arrived, can scarcely be over-estimated. For myself, I may say that after several years of work on the subject, I have been not able to add very much, except in points of detail, to what they have accomplished; and the testimony of others is the same. In Nov. 1870 J. P. Mansel-Weale † applied the results which had been previously arrived at to certain South-African genera and species of the natural order, viz. *Gomphocarpus*, R. Br., *Xysmalobium*, R. Br., *Pachycarpus*, Mey., *Periglossum*, Decaisne, and *Cordylogyne*, Mey.; and elicited the remarkable facts that in some Asclepiads no movements of the pollinia ever take place, that in others the movements are slight, while in *Periglossum* and *Schizoglossum*, Mey. (*Aspidoglossum*), it takes place in an entirely different and even in a reverse direction from that presently to be described in the case of *Asclepias Cornuti*. Dr. Hermann Müller, in his admirable 'Befruchtung der Blumen durch Insekten,' published in 1873 ‡, confirms the results of Hildebrand and Delpino, but adds little that is new, except that he details a very valuable list of the exact species of insects which are visitors to these plants, and the third part of his 'Weitere Beobachtungen über Befruchtung der Blumen durch Insekten,' p. 61, published in 1882, contains a supplementary list.

B. *Mode of Pollination.*

In fine weather (for in bad weather pollination is not effected), on the warm days of summer, numerous Hymenopterous insects,—viz. Wasps, especially *Scolia hortorum* and *S. bicincta*, and Bees, especially the Hive Bee and the Humble Bee, and also Flies—enticed by the sweet, heavy perfume of the flowers and the bright sunshine, alight on the umbel, to make use of the sweet nectar existing in the nectaries. The insect, alighting on a flower, takes up the position most convenient for sucking. It grasps the back of a nectary, and plunges its proboscis into its cavity, endeavouring at the same time to get

* "Ueber die Befruchtung von *Asclepias Cornuti*," Bot. Zeit. 1866, no. 48, pp. 376–380. 'Die Geschlechter-Vertheilung bei den Pflanzen,' 1867, pp. 58–59 & 80. Fredric Delpino's "Beobachtungen über die Bestäubungsvorrichtungen bei den Phanerogamen, mit Zusätzen und Illustrationen." Bot. Zeit. 1867, nos. 34, 35, 36, pp. 266–270 & 273, plate vii. figs. 1–5. "F. Delpino's weitere Beobachtungen über die Dichogamie im Pflanzenreich, mit Zusätzen und Illustrationen." Bot. Zeit. 23rd Sept. 1870, no. 38, pp. 604–606 (*Ceropegia elegans*), abridged translation in German of the 'Ulteriori Osservazioni.' Bot. Zeit. 1871, p. 746, note on *Asclepias tenuifolia*.

† "Observations on the Mode of Fertilization of certain Species of Asclepiadeæ," Journ. Linn. Soc. Bot. vol. xiii. pp. 48–58.

‡ Pp. 334–338, figs. 122–123.

a firm and sure foothold on the unstable flowers, which nod upon their extremely slender pedicels. In doing so it keeps up a continual movement with its feet, which cling only with very great difficulty to the convex and extremely smooth external surface of the nectary on which they have been set. The hooked claws of the feet of such an insect, being unable to retain their hold on the nectary, are apt easily to glide off this laterally into one of the smooth more or less concave valleys which intervene between the particular nectary on which it has settled and those which are next adjacent *. This concave valley is in its lower part, between the bases of the nectaries, slightly more depressed. In the centre of this valley runs one of the alar fissures. Into the wider portion of this the insect at length places one or other of its feet, and being by this means afforded for an instant the firm foothold which it desires, the hooked claws diverge. If the insect, however, while it is slipping downwards, sets its foot first on the partially divergent grooved margins of the anther-alæ, these, being very thin, bend slightly backwards, and the foot immediately slips down till it reaches the notch near the lower extremity of each (*k*, figs. 5, 7, & 8), where it is arrested and stops. The two fleshy teeth which embrace the bases of each pair of anther-alæ (*m*, *m*, fig. 10) prevent the latter from being bent backwards for too great an extent, and serve in part to cause them again to come together externally after the insect's foot has entered the alar chamber through the notch-like expansion at its base †. When the insect endeavours to withdraw its foot in order to proceed further, or shifts its position ever so little, the divergent claws are easily caught by the contiguous opposed borders of the neighbouring anther-alæ, and the insect soon finds that the only mode of escape is to slip the foot gradually upwards in the channel of the alar chamber towards the apex of the flower. Should it, however, endeavour to pull its leg out directly, in its effort to do so its leg is frequently caught so fast by the gradual narrowing of the channel of the alar chamber, due to the decrease in breadth of the alæ, that it requires to use all its strength in order to get free, and so it often happens that the insect lets go its hold of the flower with all its other legs, and endeavours with its whole strength to extricate and extract that member which is caught. This latter phenomenon may be observed frequently and with ease in the case of the ordinary Hive Bee (*Apis mellifica*), but never in the case of the Humble Bee (*Bombus italicus*), since the latter, owing to its greater strength, is able more easily to become free, although not without considerable trouble. Very often the insect is unable to extricate its foot, and so a leg becomes torn off, and is left behind hanging in the fissure, several joints even being thus removed; and yet notwithstanding this the insect, unwarned by experience of the danger which it incurs, continues its visits to this perilous flower, often greatly to its own detriment.

The drawing out of the leg is, however, in most cases performed without such violence,

* [I have never noticed this. The feet of Flies are well adapted to cling to a smooth surface; they keep them moving about, but I have not noticed them distinctly slip, and in some genera, as in certain species of *Piaranthus*, R. Br. (not of other authors), they could scarcely slip if they tried.—N. E. Br.]

† The anther-alæ never diverge from one another to any extent below, as they have frequently been stated to do: on the contrary, in the mature flower they are subparallel, except for their slightly grooved extreme margins. The mode of entrance into the alar chamber is always at the notch.

being accomplished by the foot remaining included between the alæ while a simple, quiet dragging motion of the leg upwards in the alar chamber takes place in a perfectly vertical direction. As the apex of each of the alæ terminates immediately above the lower border of the widely expanded base of the black corpusculum, it follows of necessity that when the foot reaches the superior end of the alar chamber in which it has been guided, one at least of the two hooked claws upon it, or some part of the foot in the case of *Diptera*, must easily enter the hollow cavity of the corpusculum, which lies in such a position that this result is inevitable *. If the leg is then drawn further upwards, part of it travels along the fissure on the anterior side of the corpusculum, the hooked claw of the tarsus being firmly caught and held by the projecting margins which bound the chink, and which gradually converge superiorly, so that a wedge-shaped fissure is the result. Its foot and leg in this way become so firmly fastened that the insect, finding itself fairly and completely caught, begins to make efforts to free itself, and in its further movement draws its foot forcibly outwards and slightly upwards. By so doing the insect detaches the whole corpusculum from its excreting furrow, to the bottom of which this body is not at this stage in any way adherent, and then draws it outwards likewise, together with the pair of pollinia which are attached to it by means of its "appendages," and which are pulled out of their open pouches and carried away (fig. 19). If, however, the leg is, on the contrary, pushed downwards, the insect is unable to bring away the pollinia; but if it is strong, it tears the corpusculum away from its "appendages" and escapes with it; while if it should happen to be small and weak, as *e.g.* a small Fly or an Ant, it is unable to do this, and remains hanging to the corpusculum, being in this way kept a prisoner, and must either release itself by detaching a leg, which may be then found attached to the corpusculum, or, being unable to do so, *e.g.* in the case of the Ant, it perishes by starvation †. The corpusculum is not, then, as it is commonly said to be, cemented or adherent to the insect's leg by any viscous matter. On the other hand, the connexion of the two is owing simply to the fact that the limb of the insect, entering the hollow cavity of the corpusculum in a position determined by the surrounding parts, is firmly caught fast in its fissure, owing to the peculiar configuration of the latter, which, as has been shown, is wide at first inferiorly, and rapidly narrows upwards to a point.

Further, in the expanded flower the corpusculum is not at all adhesive or viscid ‡, but is hard and possesses a perfectly firm, smooth surface. Its shining appearance has perhaps led those ignorant of its real mode of formation and the subsequent changes which it undergoes to conjecture that it was sticky. The adhesion, then, cannot be due to any cementing liquid, neither is the vertical fissure on the anterior surface of the corpusculum

* [The hooks of the tarsi have very little to do with the retention of the leg or withdrawal of the pollinia, as it often happens that the proboscis, or even single stout hairs on the legs of an insect, enter the alar chamber, and are caught by its elastic sides, and so withdraw the pollinia.—N. E. Br.]

† The operation of extraction by insects may be easily observed by the simple expedient of placing the hand over the blossoms at some distance above them, when, the insects which have settled there being startled by the shadow and attempting to fly upwards, their feet become caught within the alæ on which they are resting for support, and thus the pollinia are extracted.

‡ As stated most recently by C. Darwin, *vide* 'The Effects of Cross and Self-fertilization in the Vegetable Kingdom,' p. 375.

at all glutinous or adhesive, as Prof. Asa Gray regards it to be*. On the contrary, in the mature corpusculum its whole internal surface is firmer in texture, darker in colour, and older in point of development than the external surface; and as this anterior boundary forming the margins of the fissure is the earliest part of all to be developed, it possesses the above-mentioned features in a preeminent degree.

From the time of Kölreuter † onwards various observers, Sprengel among others, and in recent years an American investigator, Mr. Edward Pott ‡, have either imagined or held that the corpusculum possesses the elasticity of a trap, so that when the leg of the insect comes between the two sides of the fissure and touches them, they immediately come together and, closing on the member, hold it fast. The last-named gentleman, who worked with the species *Asclepias curassavica*, L., and *A. incarnata*, L., describes the corpusculum as being both "sensitive" (irritable) and "contractile," the former property residing in the posterior (inner) surface, the latter in the parts of the anterior surface which bound the fissure. He mentions that, on stimulation of the posterior surface of the corpusculum by contact with a foreign body, contraction of the part forming the margins of the fissures takes place, so that these margins are quickly approximated, and the fissure is almost closed. It is almost needless to say that the endowment of an inert body, such as the corpusculum is, and such as I have developmentally proved it to be, with properties which belong only to *living* protoplasm is purely imaginary and fanciful, and is, moreover, founded on misinterpreted observations.

If the insect has drawn out a pair of pollinia, it sometimes makes efforts to remove them, but always in vain. The two pollinia, immediately after their extraction from the anther-cells, stand widely apart, with their less convexly curved edges, which, when *in situ*, are directed towards the sides of the cells next the alar fissure, facing one another. Their more convexly curved edges, which *in situ* are directed towards the median line of the anther, stand away from one another; for up till this time the gum composing the corpuscular appendages has remained moist and semifluid, being still attached to the excreting cells of their furrows and not being exposed to the air, for they are hidden from view by the anthers which lie closely upon them. A few moments after the whole corpusculum with the pair of pollinia attached to it by means of its "appendages" is withdrawn, the "appendages," being exposed to the air, dry up. During this process they undergo peculiar movements, being rotated inwards on themselves rather below their middle portion in such a manner that the two pollinia fold together towards that side which formerly, when the whole apparatus was *in situ*, faced the centre of the flower, and are drawn so as to lie close to one another, with their broad diameters nearly parallel. In this manner, and by means of these movements, they attain exactly that position in which they can with ease be inserted or pushed into the lower cordate expansion of one of the five alar fissures leading to the truly stigmatic portion. The insect, being now furnished with these pollinia, proceeds with its work of collecting honey, either from the nectaries

* 'Structural Botany,' 1880, p. 324.

† "Anthera contortum," 'Actorum Academiæ electoralis Theodoro-Palatinæ V.' vol. iii. Physic. 1775, p. 41 *et seq.*

‡ 'Proceedings of the Academy of Natural Sciences, Philadelphia,' 27th Aug. 1878, pp. 293–296, figs. 1–4.

of the same flower from which the pollinia have just been extracted, or from those of a neighbouring one. In doing so it repeats the same actions which it exhibited in its previous search; for, scrambling onwards and creeping with its feet on the smooth surface, it progresses manifestly with difficulty and in a very unsteady manner, since it is continually slipping. It is thus in its efforts naturally enabled to get one of its feet caught in the notch-like expansion of one of the alar fissures. If the foot so caught happens to have one or more pollinia attached to it, these are quite easily inserted into the alar chamber through the expanded notch when the insect, endeavouring to free itself, raises the leg to which they are appended upwards in the channel of the chamber. Owing to the peculiar movement of the pollinia, described above, the more strongly convex border of each of them is turned away from the observer and towards the alar fissure, and is in front when the pollinia are inserted into the alar chamber through the notch. From this edge alone, as will be seen more fully hereafter, the pollen-tubes are emitted. If the movement did not occur on the part of the pollinia their broad surfaces would lie at right angles to the alar fissure, and their insertion into it in this position through the notch would in consequence be rendered a much more difficult, if not an altogether impossible operation; or else the pollinia in being slipped in would become folded in the opposite direction, and the less curved border, which emits no pollen-tubes, would be first inserted into the fissure. By raising its foot still further the pollinia, after being introduced into the alar chamber, are drawn upwards, one slightly in front of the other, the breadth of the innermost part of the alar chamber not being sufficient to allow them to go abreast. They proceed upwards until the most convex point of the more curved edge of one of them is opposite to, and in contact with, the point where the outer sloping portion of the base of the style-table abuts against the apex of the staminal column, *i. e.* with the true stigma. This portion of the alar chamber has been modified into that form which is precisely the best to receive the pollinia and to maintain them firmly in a position where they can effectually insert their pollen-tubes into the stigmatic tissue, and is, in short, so adapted to the form of a pollinium that it is no exaggeration to say that it appears almost as if it were the mould in which the pollinium had been cast. Above the point now occupied by the widest portion of the pollinium the alar chamber, whose dimensions gradually decrease upwards, becomes of such a limited area that it is unable to admit of the further passage upward of two bodies of such large size as the pollinia are. As the insect, therefore, by a powerful pull, overcomes the slight resistance which it experiences*, and extricates its foot, it tears across the "appendages," which connected one or both of the pollinia to the corpusculum and are never very strong, leaving the pollinium hanging, firmly caught in the alar chamber opposite, and close to the true stigma. The pollinium so abandoned is no longer visible from the exterior, but is completely hidden, and can only be seen on removing the anther-alae by section. Thus the pollination of the flower is accomplished, identically the same mechanism so ingeniously serving both for extraction of the pollinia and for their subsequent insertion. The corpusculum, along with its two broken appendages, is carried off by

* This resistance is easily felt in artificial pollination.

the insect, firmly fastened to its foot, and follows the course of its leg up the chamber*. Both of the pollinia may occasionally be left, but more usually one only is so. If one is withdrawn I should imagine that it turns its larger diameter more obliquely, and so is enabled to pass through the contracting channel. The leg which bears the corpusculum carries with it, attached to it, considerable portions of either one or both of the broken and detached "appendages," since the rupture occurs either where the pollinium joins the appendage, though this is rare, or more commonly at the flexure, a small portion, generally only that below the flexure, remaining attached to the pollinium. When the leg so provided has pursued its way upwards and arrived at the superior end of the alar chamber, a good outward pull on the part of the insect is required to extricate it. It thus happens that the broken end of an "appendage" becomes firmly caught in the wedge-shaped fissure of the corpusculum which is seated there. This new corpusculum, with the two pollinia appended to it, is then extracted and carried off attached to the former corpusculum by means of the broken "appendage." A fresh corpusculum, with its appendages and pollinia, is thus carried away by the insect each time it completes the pollination of a flower, if it has not been already removed; and from the foregoing account it will be clear that the insect alternately gets pollinia attached to itself and again loses them. Each corpusculum, then, is placed at the superior end of an alar fissure, not alone because it is very small and unlikely otherwise to be touched by the insect, as Sprengel thought (*loc. cit.*), but in order that insertion of the pollinia may be accomplished by the same mechanism which serves for their extraction, and may, sometimes at least, immediately precede the latter part of the operation.

Most curious and remarkable combinations of corpuscula-bearing pollinia with one another are occasionally to be met with, and were first figured by Brown †, although he says nothing whatever about the method by which they were produced. These combinations are either attached to unremoved but displaced corpuscula, or to the claws of the insects which effect the pollination of these flowers, and which present a most singular appearance when equipped with them. The simplest case of such a combination which can occur, viz. two corpuscula and three pollinia, has been already noticed, together with the mode in which it is formed. This combination being inserted into the alar fissure, as the single corpusculum was previously, one of the two lower pollinia is left detached in the lower part of the chamber, whilst its appendage, becoming caught at the upper part in the fissure of the corpusculum which lies there, carries it away, forming a combination of three corpuscula and four pollinia. This may be repeated again and again with inevitably the same result: one of the pair of pollinia last extracted is left in the alar chamber, while a new corpusculum, with its two pollinia, is each time withdrawn, and so a row is formed. These corpuscular combinations are, however, frequently more or less

* From some observations of Dr. Hermann Müller's, it is clear that a strong insect is able to insert pollinia and then escape with the corpusculum, without, however, extracting another also. This it must do by a powerful oblique pull, so that the foot is forcibly withdrawn before it can travel the whole length of the alar chamber. Müller found pollinia inserted into the alar chambers of flowers from which no corpuscula were withdrawn; and this has also been confirmed by Mr. Weale's researches (*loc. cit.* p. 54) on *Gomphocarpus fruticosus* and *G. physocarpus*.

† *Vide* plate xxxii. figs. 4–6, Atlas of plates to Misc. Bot. Works.

regularly dichotomous in their arrangement, and this can only occur by one of the projecting corpuscular appendages, either with or without a pollinium attached to it, becoming caught in the open lower extremity of an alar chamber; it is then drawn upwards in the cavity, its pollinium, if it has one, is usually detached in the lower part, and then in any case the appendage simply passes upwards as the insect raises its leg and lifts out the corpusculum situated at the apex of the chamber, along with its pair of appended pollinia. I am unable to conceive that this dichotomous form can be brought about in any other way, since the alar chamber is in all cases of much too contracted dimensions to admit of the passage of any form of combination except a unilateral series such as that previously mentioned, *i. e.* a combination with a single pollinium directly attached to each corpusculum save the last, which has two pollinia. Several of the most curious and complicated of these dichotomous series which have actually been met with will be found figured in the plates (figs. 20 & 21). Very frequently in those combinations which are found attached to displaced but unremoved corpuscula the presence of a portion of a corpuscular appendage in the fissure of the uppermost corpusculum of the series indicates clearly that the combination had once been larger and more complex, but has become broken. Be the combination what it may, in no case does the connexion occur by means of one corpusculum being fastened directly to another, but always by means of the remains of the ruptured appendage, or appendages, as the case may be, of one corpusculum being each firmly caught in the fissure of another.

Dr. Hermann Müller quotes * the interesting case of a butterfly resembling a *Vanessa* which was observed by Fritz Müller to visit the flowers of *A. curassavica*, L., and which had on one leg not less than eleven corpuscula belonging to this Asclepiad; but of the twenty-two pollinia which formerly were appended to these only eight were present, the others having in each case gone to fertilize other flowers. In three cases combinations are exhibited in his accompanying woodcut †.

The corpusculum itself never remains in the alar chamber, and is very difficult to remove and detach from the insect's foot, and may be often attached to the foot when the insect is caught. I have frequently seen bees and flies which, in their repeated visits to flowers, had numerous corpuscula with their several pollinia attached to almost every leg, and sometimes in combination; yet these insects did not seem to experience much annoyance. Hildebrand mentions ‡ the curious fact that frequently the proboscis of bees which visited the flowers of *Asclepias Cornuti* was not devoid of pollinia, since it also in the search for honey had been inserted into and drawn up the alar chamber in the same fashion as the foot. This observation is peculiarly interesting, as affording a sort of transition, though purely an accidental one, between the action of insects on the flowers of those Asclepiad genera, viz. *Gomphocarpus*, *Centrostemma*, and *Hoya*, in all of which, as in all the species of *Asclepias*, transference of the pollinia is accomplished by means of the hooked claws of the feet, and on the other, their action on those like *Cynanchum*, *Vincetoxicum*, *Boucerosia*, *Stapelia*, *Araujia*, Brot., and *Pergularia*, L., in which the stiff bristles on the proboscis are the agents in carrying off the pollinia.

* *Loc. cit.* p. 337, fig. 123.

† Compare also Mr. Weale's paper (*loc. cit.* p. 53).

‡ Bot. Zeit. 1866.

In the former class there is a correlation of the five nectaries being formed by the cuculli and lying opposite the five anthers, of the exserted condition of the entire staminal column bearing the anthers which surround the style-table, and of the reflexed or spreading condition of the calycine and corolline lobes; in the latter class the five nectaries alternate with the five anthers.

Repeated allusion has already been made to the fact that pollination is only possible by means of insect-agency, or in an artificial manner. Yet, inasmuch as several observers, among whom may be cited Ehrenberg *, Adolphe Brongniart †, Schauer, and, more recently, Mr. Edward Pott (*loc. cit.*), have regarded the production of pollen-tubes by the pollinium while still unremoved from its cell, and the entrance of these tubes through the medium of the truly stigmatic surface into the styles and thence to the ovules, as either a possibility or a matter of actual occurrence, the facts at our disposal regarding such self-fertilization with the pollinium *in situ* deserve a brief consideration.

Brongniart believed that the lower $\frac{1}{3}$ of the pollinium still remains seated in the anther-cells while rupture occurs in the middle $\frac{1}{3}$, and he actually figured it so ‡. He was, naturally enough, unable to understand how such rupture could take place without the action of a liquid of any kind; in order to account for it, however, he supposed that the pollen-tubes were produced either by the gradual development of all the parts of the flower, or else, more probably, that the corpusculum and its appendages transmit a liquid, which is secreted by the corpuscular furrow of the style-table, into the pollinium, and that the entry of this liquid determines the swelling of the pollen-grains §. He never suspected the intervention of insects, although Brown had previously expressed his belief in the need for its occurrence. Mr. Pott, who is perhaps, in modern times, the strongest, and, indeed I may say, the *only* adherent of this view that self-fertilization is possible under the circumstances before enumerated, expresses himself thus concerning it:—"There is no imperative physical obstacle to self-fertilization [with the parts *in situ*], the inner membrane of the anther being cut away apparently for the purpose of allowing or promoting self-fertilization;" and, further, "Self-fertilization is absolutely certain, failing insect-friends [on which he admits fertilization does largely depend] or violence extracting the pollinia before the pollen-tubes are produced." This observer, however, tells us, notwithstanding, that in the two species of *Asclepias* which came under his notice, viz. *A. curassavica*, L., and *A. incarnata*, L., "none of the pollen-masses while *in situ* produced tubes, although several of the pollinia *in situ* had strongly marked granulation, and tendency to rupture appeared in those cells adjoining the convex edge." Delpino, who vigorously contests the truth of this view, affirms the same thing, and evidently got a similar result; for he tells us that "on no single occasion did he see the pollinia produce pollen-tubes while *in situ*" ‖.

* Ehrenberg, 'Linnæa,' iv. p. 94, 1829; also "Ueber das Pollen der Asclepiadeen," Trans. Royal Acad. of Sciences of Berlin, Nov. 1831, and separately, Berlin, 1831.

† "Quelques observations sur la manière dont s'opère la fécondation dans les Asclépiadées," Ann. des Sci. Nat. vol. xxiv. 1831, pp. 263–279, pls. xiii. & xiv. A & B.

‡ *Loc. cit.* pl. xiv. fig. 5.

§ Compare Payer's view of the action of the corpuscular appendages, 'Organogénie,' vol. i. p. 569, quoted at page 35.

‖ Sull' Appar.

So far, then, there is no direct evidence in favour of self-fertilization under the conditions specified. On the contrary, Brown found * that "in the gradual decay of the flower in *A. phytolaccoides*, Pursh., when the parts remained soft, the rupture [of the pollinium] and protrusion of tubes took place while the pollen-mass was still in its original position immersed in the anther-cell †. The tubes produced in this situation often acquire a great length, but coming, immediately on their protrusion from the pollen-mass, in contact with the anther-membrane (*i. e.* the vertical dissepiment), their course is necessarily altered, and in their new direction, which is generally upwards, they not unfrequently arrive at the top of the anther-cell, or even extend beyond it." I may add that I have repeatedly observed exactly the same phenomenon to occur with *A. Cornuti* when old ‡. In no single instance, therefore, even though the pollen-tubes may happen to be produced while the pollinium is still *in situ*, is it possible for them to meet and penetrate the true stigma. On the contrary, they are invariably deflected away from it; and a very slight observation of the relative position of the parts of the flower as they actually are will convince the inquirer that Mr. Pott's idea concerning the adaptation for the purpose of self-fertilization of the inner wall of the anther-cell is completely untenable. The part of it which is removed on dehiscence never forms a sufficient portion of the whole longitudinal length of the wall to permit of any other fate for the pollen-tubes, in case they are produced, than that of deflection upwards. These tubes, moreover, are always produced from the inner or more convex of the two edges of the pollinium; and this edge, when the pollinium is *in situ*, is closely adjacent to the median vertical membranous partition separating the two anther-cells, so that the tubes, if produced, would at once encounter this, and immediately on their doing so assume an upward direction. Any idea, then, that self-fertilization either takes place or is possible, when the pollinium is still *in situ*, must be erroneous; for it both has been and can be shown, from the position of the parts as well as by direct experimental evidence, that it cannot occur.

If they are not disturbed, insects often remain for a long period, often for entire hours, on the same umbel, and in consequence they search a large number of flowers on the same plant before flying to another. This was observed by Delpino to be especially so in the case of *Scolia hortorum*; and I have seen it in the case of the hive-bee. Hence it at any rate appears to be possible :—

(1) That the pollinia extracted from the anthers of a given flower may be inserted into the lower portion of other alar chambers of the same flower; and

(2) That the greater part of the pollinia inserted into the alar chambers of any given umbel belong to and were previously extracted from the flowers of that same umbel.

* Misc. Bot. Works, vol. i. p. 529.

† *Vide* Atlas, plate xxxv. fig. 11, and Linn. Trans. vol. xvi.

‡ Charles Darwin has observed the emission of pollen-tubes from the pollinia while still within the anther and not in contact with the stigma in semimonstrous flowers of *Malaxis paludosa*, Sw., and of *Aceras anthropophora*, R. Br., also in perfect flowers of *Neottia Nidus-avis*, Rich., three widely distinct Orchid genera, which are, in nature, all cross-fertilized, though the last mentioned seems to possess the power of self-fertilizing itself in some degree if insect visitors fail it. *Vide* 'Fertilization of Orchids,' 2nd edit. p. 258. This feature is also general in cleistogamic flowers. *Vide* 'Forms of Flowers,' p. 337. Hofmeister (Neue Beiträge, ii. pp. 642, 643) has further observed that the pollen-grains of *Naias* very often develop long tubes while lying in the loculi of dehisced anthers.

The former, however, though possible, probably very seldom occurs, since the insect is unlikely to get the identical foot which extracted the pollinia again caught in the fissures of the same flower; and I have, moreover, frequently observed that the circumstance of the insect having to exert force to extricate its leg from the apex of the alar chamber startles and annoys it a little, so that it immediately leaves that flower of the umbel and proceeds to the first adjacent flower. Some considerable time, moreover, must elapse after the pollinia are extracted before the corpuscular appendages are so far dried that both pollinia of the same corpusculum can be introduced through the fissure into the alar chamber, and in the meantime the insect has had time to reach another flower or plant. Yet, notwithstanding these possibilities, the great law first clearly enunciated by Andrew Knight * at the close of the last century, in the form that "no hermaphrodite fertilizes itself for a perpetuity of generations;" and, after the lapse of years, again in 1862 by Charles Darwin, at the close of his 'Fertilization of Orchids,' in the words, "Nature tells us, in the most emphatic manner, that she abhors *perpetual* self-fertilization," will be found to hold good for the Asclepiads, as well as for the Orchideæ and the rest of the Vegetable Kingdom.

Each umbel is composed of from 20 to 50 closely approximated flowers; but of this extremely large number only one, or perhaps two, ripen seed, while all the others soon become disarticulated and fall off.

The only case which seems exactly to resemble it that occurs to me is that of the Horse-chestnut (*Æsculus Hippocastanum*), quoted by Darwin †, where only one or two of the several flowers arranged in a thyrsus on the same peduncle produce a seed; and this seed is moreover the product of one out of several ovules in the same ovary. The determining cause in both cases which enables certain of the flowers to develop fruit to the exclusion of the rest, is to be found in the circumstance that these flowers have been pollinated with pollen or pollinia extracted from flowers belonging to another individual of the same species; since, in this case, the resulting production of tubes appears to be attended with greater vigour and energy, while all the others have been pollinated simply with pollen or pollinia derived from the same individual to which they themselves belong; in other words the fertilizing influence of pollen derived from another, is prepotent over that derived from the same individual. We know from the experiments of Herbert and others detailed by Darwin ‡, that if one flower is fertilized with pollen which is more efficient than that applied to the other flowers on the same peduncle, the latter often drop off; and it is probable that this would occur with many of the flowers on the same plant which had been self-fertilized with pollen derived from the same individual, if other and adjoining flowers were cross-fertilized by pollen brought from another.

So far as I have been able to determine by direct experiments, the flowers of *Asclepias Cornuti* are absolutely sterile when fertilized artificially with pollinia extracted either from the same flower or from one of a like age; though these pollinia when inserted produce each their skein of pollen-tubes which penetrates down into the interior

* 'Philosophical Transactions,' 1799, p. 202.

† 'The Effects of Cross and Self-fertilization in the Vegetable Kingdom,' p. 399.

‡ 'The Variation of Animals and Plants under Domestication,' 2nd edition, vol. ii. pp. 120–122.

of the style *. This, however, soon ceases to progress further, and, indeed, never attains a very great length; the pedicel of the flower withers and becomes disarticulated from the peduncle, and then the flower itself falls off, both the pollinium and the stigma having remained fresh in appearance during this time; they seem, therefore, to have no deleterious effect upon one another. The emission of a skein of pollen-tubes by the pollinium, in the usual manner, and the fact that this skein may ultimately enter the cavity of the ovary, appears to be a contingency insufficient in itself to ensure the production of an embryo. This was first clearly shown in 1867, by Delpino. Sterility must, then, be ascribed in these plants to some other cause than that of inefficient pollination, and can only consist in the want of adequate cross-fertilization.

In warm weather hive- and humble Bees work very diligently, so that even in flowers of *A. Cornuti* which have been only a few hours expanded, no pollinia can be found remaining in their original situations, all being already removed. Notwithstanding this, I have been able to confirm Hildebrand's interesting observation that in these flowers, while they are still young, it seldom happens (though it may do so, as will presently be shown) that pollinia are to be found inserted in the alar fissures of the *same* plant, and it is only when these flowers become somewhat older that pollinia are to be found inserted in their alar chambers, and producing their skeins of pollen-tubes †. This observation clearly indicates that insects for the most part do not fertilize the flowers of this species with their own pollinia, but carry pollinia from younger flowers to older ones. Thus, if only the central flowers of the cymose umbel be expanded, the pollinia brought to them by insect visitors must, at least, be those of a different umbel, and very probably those of a different individual; while the pollinia extracted are carried away in like manner. If, however, the entire umbel is expanded, the more central flowers will already have had their pollinia extracted; and should the insect alight on one of the outer flowers first, it may possibly deposit in the alar chambers of the more central ones the pollinia it has extracted from those which are more external. In this case it will, however, sometimes have deposited in the alar chambers of the outer flowers the pollinia obtained from young and newly expanded flowers, either of the same individual or probably of a different one; though frequently it may come to these flowers destitute of pollinia of any kind. The insect, however, so far as my experience goes, very rarely pursues this order of visitation, but usually alights first on the central flowers of the umbel and pursues a reverse order. Having alighted, it deposits pollinia brought from another umbel or another individual, while it takes no pollinia in return, since these latter have already been withdrawn ; but it extracts pollinia from the outer and younger flowers by means of the ruptured appendages of the pollinia

* I cannot agree with Mr. Weale's conclusion (*loc. cit.* p. 57) that the flowers of Asclepiads probably require to be pollinated each with several pollinia in order to be productive, and that the absence of this leads to the production of such a very small quantity of mature fruit: for if a flower be pollinated with a *single pollinium* from a perfectly distinct individual, ripe fruit and good seed will be produced. Such paucity of fruit is only due to insufficient nourishment if all the flowers are adequately cross-fertilized, and to inefficient fertilization if they are not so.

† Mr E. Pott (*loc. cit.*) states just the reverse of this; but Hildebrand's conclusions are fully supported by my own researches.

which it previously bore, and carries them in turn to the central older flowers of another umbel. In this case cross pollination, between the umbels at least, invariably takes place, and is also frequent between different individuals. In the case of curious combinations of corpuscula-bearing pollinia, the possibility of the insertion of pollinia from one flower into a neighbouring one of the same umbel occurs. Yet even here I have frequently observed that the combination is formed by the successive insertion and extraction of corpuscula derived from young flowers (whether central as in the early condition, or circumferential as in the later) of one umbel into the central flowers of another which are of a similar age, so that even in this case cross pollination between separate umbels and often between distinct individuals is ensured.

The extraordinary number of flowers which a hymenopterous insect is able to search within a very short space of time increases the chance of cross pollination, as does the fact that they are unable to perceive without practical experience for themselves whether the store of nectar in a flower has been already exhausted.

If all or nearly all the flowers of an umbel are pollinated, those which are so by pollinia derived from another individual will, as we have already seen, fare best and outstrip those which are fertilized by pollinia from the same or other umbels of the same individual; so that the former alone in this case will set seed. Further, should a flower be pollinated by means of pollinia derived from the same individual, and also even at a subsequent period by pollinia obtained from a different one, the pollen-tubes of the latter will outstrip those of the former in their action, and the ovary which they enter will alone ripen into fruit. The relative priority of pollination in the different flowers which have been efficiently cross-pollinated no doubt exercises an important influence in determining which of these shall develop further in preference to the rest, since only a limited amount of fruit can be efficiently nourished. In another species, *A. Michauxii*, Decaisne (*A. angustifolia*, Ell.), I have found that the flowers of one individual are fertilized more freely by pollen from a distinct individual than from its own, yet, if access to the pollinia of another individual be denied, those flowers which are pollinated by the pollinia of younger flowers of the same individual set seed easily and readily, although they are sterile to their own pollinia; they are, therefore, only partially self-sterile*. I am by no means, however, prepared to affirm that the same is true of *A. Cornuti* as of this last-named species. On the contrary, what observations and experiments I have been able to make on the subject tend distinctly to the reverse conclusion, and I regard the flowers of *A. Cornuti* as utterly self-sterile. For while the stigmas of the flowers of every individual are perfectly normal, and their ovules are perfectly fertilized and produce a full complement of seed with the pollinia of any other *distinct* individual of the same species, not one of these flowers produces a single seed when fertilized by pollinia derived from the same individual plant to which it belongs. These pollinia, notwithstanding, fertilize completely the flowers of any other *distinct* individual save their own. This self-impotency may be due in this case, as in so many others, to the change of circumstances to which the plant is exposed in the climates of Europe; but Prof. Gray tells me that no

* I unfortunately did not observe the proportion of seeds produced by cross pollination to that produced by self-pollination in this species, nor the relative vigour of the seedlings produced from them.

observations have been made in America upon the fertility of any *Asclepias* living under its natural conditions, and I cannot, in consequence, speak definitely upon this point, although, judging from Delpino's experiments in Italy and my own in this country, I believe that it is not so. I have fertilized flowers of *A. Cornuti* with pollinia taken from other flowers of the same individual plant, from flowers of plants also which had been propagated by buds from the same stock though growing on separate roots, and finally from flowers of a *distinct* individual raised from seed; in the last case alone was the result successful, while in the two former, though the pollen-tubes were produced and penetrated as far as the ovary, no seeds resulted. Delpino's results are in complete accordance with my own; he fertilized some flowers with their own pollinia, others with pollinia extracted from the same umbel, others with pollinia taken from a different umbel on the same plant, and last of all, some with pollinia taken from a different individual which he believed to have been propagated by budding from the same individual. In every case the plant was equally sterile, and no seeds resulted, although in all the skein of pollen-tubes was produced, and he regards the infertility as due to the want of *thorough* cross fertilization, *i.e.*, by the pollinia of a *perfectly distinct* individual. That the self-sterility depends solely on the diminished degree of efficiency of the pollen in self-fertilization of any kind in this species is, I think, clear, since it cannot and does not depend on either the pollen or the ovules being in an unfit state for fertilization; for both have been found effective in union with other *distinct* individual plants of the same species. The penetration of the stigma and style by pollen-tubes in the cases of sterility is, moreover, not a unique phenomenon only to be met with in *Asclepias* *. Hildebrand has observed in *Corydalis cava* that the plant was absolutely sterile to its own pollen, though the pollen-tubes penetrated into the tissue of the stigma; and Mr. John Scott † found the same to be true of two species of Orchids, *Oncidium sphacelatum* and *O. microchilum,* though in all three cases it produced good seed when fertilized by pollen brought from a distinct individual, while its own pollen was in every way normal.

By raising plants of *A. Cornuti* from seed, and exposing them near together in open situations, we get fruit produced and seed set; for this is the natural process. It is worthy of note that those flowers which are not pollinated, long remain fresh, while those which have been pollinated, but in an ineffectual manner, become disarticulated and fall off a few days after it has taken place.

2. *FECUNDATION.*

When the pollinium has been placed in the stigmatic portion of the alar chamber, the following changes take place :—The pollinium is torn or forced open from within, first at the most prominent point of the edge, which is next the stigma, the rupture gradually extending for about a third of the entire length of the pollinium. The portion through which this rupture extends is usually the middle third, both the inferior and superior extremities of the edge remaining entire. Sometimes, however, the rupture may be seen

* International Horticultural Congress, London, 1866. † Proc. Bot. Soc. of Edinburgh, May 1863.

to extend through this margin for the greater part of its length. The chink which it produces is a regular cut, with irregular lacerated margins. Through this chink a great number of extremely slender, more or less elongated, filaments issue in a forward direction. When these filaments are examined they are seen to be transparent, membranous, cylindrical tubes, consisting of a cellulose wall containing granular protoplasm together with numerous vacuoles. Between these tubes a greater or less abundant amount of granular matter may sometimes be detected. The tubes lie side by side, forming a sort of skein, consisting of one, or sometimes of two limbs. They are easily observable, even with the naked eye. By dilating the aperture through which these tubes come forth, which may readily be done, and so exposing the interior of the pollinium, each of these tubes is seen to be a prolongation from a grain of pollen. The grains which have produced pollen-tubes are seen to possess very nearly the original form which they had when the pollinium was fully mature, save that they are swollen and slightly more transparent, the latter fact being due to their having lost a certain amount of the granules and vacuoles with which their protoplasm was previously crowded. It is also discovered that the production of the pollen-tubes has taken place from different sides of the pollen-grains forming the three rows previously described * as existing in the pollinium. From the grains of the row which abuts most closely on the more curved edge the pollen-tubes are produced on that side which lies away from the convex edge, except in the case of those grains which lie opposite the chink. The lacerated margins of the chink are themselves produced by the bursting of the transformed wall of the special pollen mother-cells surrounding the pollen-grains on this aspect, as well as of the general outer coat of the pollinium. In the case of the grains opposite the chink, and, indeed, of all the other grains forming the pollinium, the pollen-tubes are definitely produced from the side which lies facing the chink, *i. e.* the internal side, through the cutin membranes surrounding them which they rupture. The grains forming the central layer, when they produce their tubes, generally separate at the same time from one another. Each is, however, still surrounded by the wall of the special mother-cell, which at a considerably earlier period became chemically altered into cutin, and assumed a pale yellow colour, and which has only ruptured in this case along the part of each where the pollen-tube is produced. This cutin covering may be easily removed from the grain which it incloses without any further change taking place. The cutin walls which bound the internal faces of the two superficial rows of cells containing the pollen-grains rupture on the production of tubes from their contained grains; and as the separation from them of the special mother-cells of the central row with their contents (viz. pollen-grains) and cutin walls takes place at the same time, this rupture occurs to such an extent that the remains of the cutin walls which bound these superficial cells internally cannot be easily distinguished. A very few pollen-grains may perhaps be detected in the pollinium which have not produced pollen-tubes. Some of the pollen-grains may also be found discharged from the pollinium through the chink still unchanged, while some of these, again, have begun to produce pollen-tubes like those which are still inclosed. The pollen-tubes are directed from all parts of the pollinium

* "On the mode of development of the pollinium in *Asclepias Cornuti*," Linn. Trans. Bot. ser. ii. vol. 2, pp. 75–84.

towards the open chink, and the whole pollinium has in consequence become somewhat larger than it originally was. Brown, who observed them carefully, says that each is "about $\frac{1}{2000}$ of an inch in diameter, neither branched nor jointed, and with no apparent interruption in its cavity"*. As the pollen-tubes grow in length they do so apparently at the expense of the granules contained in their protoplasm, which are used and converted into formative material; for these granules become markedly fewer, and this is more especially the case the longer the tube becomes, those in a long tube being few or altogether absent. As has been already mentioned, there is no other provision made for the production of these tubes in the form of irregular internal thickenings of the cellulose wall of the grain, such as are to be met with in some plants, *e. g.*, *Cucurbita.* After extremely careful observations many times repeated, I have at length in several cases satisfactorily traced the passage for some distance of the larger of the two nuclei which exist in the pollen-grain into the pollen-tube, although I have not been able to follow its changes further, and I was never able to follow it for any great distance along the tube. The larger nucleus, then, does not become broken up and diffused through the protoplasmic contents of the grain immediately before the production of the pollen-tube, as Strasburger has recently shown that it does in many other Phanerogams, but simply passes in its entire concrete form into the proximal end of the pollen-tube. What its subsequent fate may be is, however, another matter; but of this I cannot speak definitely; neither as to the fate of the smaller, *i. e.* the "vegetative," nucleus of the pollen-grain can I say much. I have never been able to trace its passage into the pollen-tube, although I have carefully watched for such an occurrence; and I have reason to think that it is perhaps redissolved immediately before the formation of the pollen-tube, as I was never able to detect its presence at that period.

The granular matter which is sometimes formed, lying between the tubes at their exit, Brongniart regards as perhaps due to pollen-grains which have burst without forming tubes, and it is exceedingly probable that such is really the case.

When the tissue forming the whole inferior surface of the style-table is examined in surface view, from the bud stage previous to the expansion of the flower onwards, it becomes evident that it is less smooth than is the case with the superior and lateral surfaces of the table, which latter are very smooth, possess no papillæ, and do not seem to secrete; and, further, this inferior surface has a slightly velvety appearance. In longitudinal sections it can be seen that this part is formed of cells more elongated and less adherent together than those covering the other surfaces. These cells form small papillæ projecting from the inferior surface in a downward and somewhat outward direction. In transverse section they are cut slightly obliquely. This papillar tissue makes its appearance at a period very soon after the fusion of the two style-apices to form the style-table. These papillar cells in the five regions, opposite to the five furrows on the stigmatic angles, extend almost, if not quite, to the extreme edge of the inferior surface in the form of five diverging bands. The five diverging bands are, however, broader than the underlying radial grooves. This papillar tissue covers not only the bands but the whole free inferior surface of the style-table, the slight pit where the surface bends upwards before meeting

* Misc. Bot. Works, vol. i p. 525.

the free portions of the two styles not being even excepted. This tissue covering the inferior surface is directly continuous, on the one hand, with the mass of tissue lining the cavities of the two styles in the region of the sutures, and on the other with tissue forming for some distance upward the central portion of the style-table between the two closely approximated fibro-vascular bundles. The papillar tissue of the stigma just described evidently escaped Brown's observation, since he expressly states that when he examined the base of the stigma he was "in no case able to observe any difference whatever in texture between that part and the general surface of the stigma" *. Nor could he discover the slightest appearance of secretion, though he expected to find there such a modification of surface as might serve to account for the rupture of the pollinium and protrusion of the pollen-tubes. Its discovery was due to Adolphe Brongniart, and was afterwards independently confirmed by Hermann Schacht, though the observations of both appear to have been overlooked. But though five shallow radial furrows exist on the upper surface of the staminal column and papillar tissue on the inferior surface of the stigma above them, the tissue of the two parts at these points is never continuous, though naturally the papillæ project obliquely downwards into the furrow, and so, *apparently*, the two parts are strongly applied together and adherent (fig. 13). Robert Brown, Brongniart, and others regarded this adherence and application as an exceedingly close and intimate one. The latter writer tells that it takes place in such a way and so strongly that *no* means of communication is left between the pollinium and the base of the style-table, but these parts are completely isolated, while Brown makes use † of the word "*union*" to imply the extent to which he believed it had taken place. Both authors speak of the skein of pollen-tubes proceeding from the ruptured pollinium as insinuating itself *en masse* between the base of the style-table and the upper edge of the staminal column by *separating* the one from the other at this point, and so opening a channel. This, it is true, the skein of pollen-tubes does to a certain extent; but I have never had the least difficulty in finding, when I looked carefully for it, the partially unclosed entrance to the radial groove, even in stages long before the production of the skein of tubes. Consequently the skein of tubes does not, I think, require forcibly to separate the closely adherent parts and so effect an entrance for itself, as these writers believed. Brown was unable to find that the cells bordering the course of the skein of tubes along the inferior angle, or at the point to which the pollinium was attached, were secretory; and I have also repeatedly failed to find any evidence that they produce an external secretion. Notwithstanding this, I think that the cellulose walls of the papilliform cells are so permeated with liquid in every part of their substance that the immediate proximity to, or actual contact with, these at the partially open end of the radial furrow aids and, in part, determines the rupture of the pollinium at the most prominent point of its convex edge and the production of the skein of pollen-tubes. This opinion is based partially on experiments which I have made on mature pollinia immediately after their extraction by immersing them in water, dilute glycerine, strong glycerine, and solutions of sugar of different strengths, and partially also on a few experiments made by Robert Brown. I have invariably found that rupture of the pollinium occurred at its convex edge when it was immersed for some time in dilute

* Misc. Bot. Works, vol. i. p. 527; Linn. Trans. vol. xvi. p. 727.

† Misc. Bot. Works, vol. i. p. 526.

glycerine and in weak solutions of sugar. In both cases the skein of tubes produced attained a very considerable length. With strong glycerine the results obtained were not so successful, although in many cases rupture occurred slowly, always, however, at the same place; but the skeins of tubes which were produced never attained any very great length. This seems to have been very much the result obtained by Brown when he applied the more convex edge of a pollinium to the superior end of one of the stigmatic furrows; for this latter, even in this stage (probably Brown thought to facilitate the removal of this body by an insect's foot) continues to secrete a liquid which moistens and lubricates the surface of the cells, though the secretion is now colourless and less viscid. He found that rupture of the pollinium and protrusion of the pollen-tubes took place more slowly and less completely than when the pollinium was brought in contact with the exposed portion of the truly stigmatic surface, as it usually is in pollination. Mr. Mansell-Weale * saw a wasp belonging to the genus *Pallosoma* sucking round the corpusculum of ? *Xysmalobium linguæforme*, Harv., and is disposed to think that "this secretion may be of essential service to the flower in attracting the wasps when the more abundant store of nectar at the base of the folioles is exhausted." I am inclined to favour this opinion more than that of Brown above quoted, since the corpusculum, when mature, lies not at the base, but free at the mouth of its furrow, and is attached to the style-table only by its appendages, which are still closely connected with the cells which excrete them; hence it does not require such additional aid to assist in its extraction. The principal objection to Mr. Weale's view is that, should it serve the purpose he suggests, such a contrivance would be as likely to defeat the object of the mechanical apparatus as to favour it, inasmuch as the insect might be satisfied without extracting or inserting pollinia; though, on the other hand, having found what it is in search of, it may be tempted to remain longer upon the flower, and eventually perform one of the two operations which together make up the process of pollination.

With regard to the action of distilled water, I found that rupture of the pollinium and protrusion of the tubes did take place in *A. Cornuti*, but only after long-continued immersion, a result similar to what Brown details in the case of *A. phytolaccoides*, Pursh †.

The skein of pollen-tubes is found, when its course is traced, penetrating among the papillar cells of the tissue forming the real stigmatic surface, in a direct radial line from the point where it enters the partially open channel prepared for it, till it arrives at the point of union of the style-table with the apices of the two styles. Having arrived at this point its course is directed towards the inner side of the apex of that style which is nearest to the radius along which it has travelled, and, the papillar tissue of the stigma becoming at this point continuous with the tissue lining the interior of the style, the end of the skein of tubes passes with ease, in whole or in part, directly into the latter. In this it then begins to pursue a downward course towards the ovary. Schleiden ‡, notwithstanding Brongniart's exceedingly accurate account of the inferior stigmatic surface, evidently never fully understood the exact method in which the papillar tissue of this region was arranged. For although he was aware of the five diverging bands or cords of

* *Loc. cit.* p. 53. † Misc. Bot. Works, vol. i. p. 528; Linn. Trans. xvi. p. 728. ‡ *Loc. cit.* pp. 381, 382.

papillar tissue leading from the stigmatic angles into the interior of the styles, he was not aware that the rest of the inferior surface also was papillar, since he says "that he has never been able to decide whether the five cords enter the two styles unequally divided into two and three, or whether they unite just before their entrance into a circle which is then distributed in two equal portions in the two styles. It is just at the point where the apices of the two styles join and unite with the style-table that a separation between these two parts ultimately takes place; and Brown appears to have regarded such a separation as a necessary event *previous* to the introduction of the skein of tubes into the tissue lining the style, in order that the entrance to the apex of the style should be open and freely exposed. That it is not *absolutely* necessary is, I think, clear from the observations of Brongniart, which accord with those just detailed of my own, both of us having directly observed penetration of the skein from the stigmatic tissue into the tissue of the style without any separation of parts; and this is, moreover, evident *a priori* from the fact that the tissue of the two parts is continuous. But that such a partial separation on the inner side of the style is of advantage I will not deny, since by this means a sufficient aperture is afforded through which the whole of the tubes forming the skein may be readily inserted; while in the simpler case, which has been first alluded to, owing to the skein being composed of a great mass of tubes, only a portion of them are able to find room to penetrate in the continuous tissue, while those which are unable to do so become bent, and their free ends hang down externally below the joint. Brown also found that a certain number of tubes were excluded, even though the separation did take place, if it happened to be insufficient to admit the whole girth of the skein. I am, however, disposed to think that in many cases the separation of the two parts is due, partially at any rate, to the introduction of a portion of the skein of tubes from the stigmatic tissue into the tissue lining the centre of the style, which tubes then enlarge, causing lateral rupture of the apex of the style, and that then separation of the two parts follows. The tissue forming the centre of the style, in the middle of which the skein of pollen-tubes may be found making its way downwards, is soft and pulpy in texture, formed of transparent oblong cells with very thin walls, which appear white *en masse*. These cells are intermediate in character between those which form the papillar tissue of the receptive surface and those which form the external or superficial portion (*i. e.* that nearest to the ventral suture) of the placenta in the ovary. At its upper end they partake more of the character of the former tissue, while at its lower end they come nearer to that of the latter. This tissue is easily distinguished from that which forms the external part of the style, and is continued upwards from that forming the exterior of the ovary, *i. e.* the pericarp. The name "conducting tissue" has been aptly applied to indicate the similar function both of this tissue and the papillar tissue forming the true stigma. The course of the skein, which has now become exceedingly long, in the conducting tissue of the style is rendered obvious from the exterior by a dark line on the surface of the style near the suture, and from the interior by the walls of the passage, formed by the skein absorbing the tissue as it travels, being blackened and rendered dead, their texture being altered and somewhat hardened. The pollen-tubes themselves are rendered very evident by staining with iodine. The style itself increases considerably in girth, and the ovary enlarges owing to the effects of the fecundating influence upon its contents. I was, on two occasions, fortunately enabled to trace the pollen-tubes downwards in the conducting-tissue of the style, even into the ovarian cavity itself. In this latter they at first traversed the inner, more superficial, portion of the placental tissue which bore no ovules, and their course here, as in the tissue of the style, was indicated by a dark blackish discoloration of the tissue; they then diverged into the more internal ovule-bearing portion, which became in their course of a light fawn-colour. Further than this I was unable to follow them. Robert Brown appears to have succeeded better than any other observer, since he found that in *A. phytolaccoides* the tubes spread from this place over the whole ovuliferous surface of the placenta, from which they go off to the ovules; the free end of a single tube being in many cases attached to a definite point of each, through the tissue of which it probably penetrates for some distance, since the attachment is an extremely firm one *.

Shortly after fecundation the gynostegium separates at the point of junction of the style-table with the styles, as well as at its junction with the thalamus, and leaves the two distinct carpels freely exposed and subtended by the persistent sepals.

[NOTE.—The circumstances of the publication of this paper require a brief note. As originally presented to the Society, it comprised a practically exhaustive account of everything which the author had got together, from either literature or observation, connected with the structure and functions of the floral organs in *Asclepias*. Had he contemplated publishing his memoir as an independent work, this method of treatment would not have been inappropriate. But the conditions of publication by a scientific society obviously do not allow of the republication of matter which is already easily accessible. When the whole memoir was referred to me by the Council, I suggested the immediate printing of the portion dealing with the mode of development of the pollinium, which has already appeared in the present volume of the Transactions (pp. 75–84; pl. XVI.). I further suggested that the remainder of the manuscript should be referred back to Mr. Corry, in order that he should prepare from it a second paper, giving the very important results of his investigation into the development of the corpusculum, and the mode in which fertilization is effected. The paper, after large excisions and revision by the author, was accordingly again placed in my hands. I still found, however, that the enthusiasm which the author felt in a subject of which he had made himself a master in every detail had led him to a diffuseness of treatment which would seriously detract from the usefulness of the paper. Before, however, I could take any steps to induce him to still further condense what was unimportant in its bearing on the results of his own actual researches, the lamentable news reached me of his death by drowning on Lough Gill, in Ireland, on August 4, 1883. I felt, therefore, that, impressed as I was by the substantial value of the results which Mr. Corry had obtained, nothing remained for me but to endeavour to select from the large mass of material in my hands such passages and figures as would place before botanists the original observations which Mr. Corry had actually himself made. In doing this I have to acknowledge the invaluable assistance which I have received from my colleague, Mr. N. E. Brown, A.L.S., Assistant in the Herbarium of the Royal Gardens. As regards the mode of fertilization in the Asclepiadeæ, I found that Mr. Brown had been long studying the matter without knowledge of Mr. Corry's work; and as he was kind enough to read over the paper with me, I think it is important to record that from his own observation he quite confirms the accuracy of the results obtained by the author. He has been so good as to furnish me with the following remarks:—"Having gone over almost all the ground covered by Mr. Corry, with the exception of the experiments on cross-fertilization, I am able to testify to the general accuracy of the details given by him. The invention of the term

* Supplementary Observations on the Fecundation of Orchideæ and Asclepiadeæ, 1833; Misc. Bot. Works, vol. i. pp. 549–551.

'alar chamber' for the stigmatic cavity appears to me superfluous, but is of little importance. Two of the most interesting points in connexion with the fertilization of Asclepiads are, 1st, the great rapidity with which the pollinia are sometimes extracted by flies (and before I understood the real manner of their extraction I was much puzzled to see a fly suddenly withdraw the pollinia, whilst watching it under a lens, and yet not see *how* it did so); 2ndly, the great ease with which the pollen-masses slip into the stigmatic cavity, especially when applied by insects, their disappearance into the cavity being quite sudden." A few brief footnotes furnished by Mr. Brown will also be found in the text of the paper. The Council having approved of the course I recommended, I have simply contented myself with giving, in Mr. Corry's own language, all that relates to the development of the corpusculum and the mode of fertilization. Mr. Corry's style is often difficult, and sometimes obscure; but this I have not attempted to mend. I have, however, taken the liberty of throughout substituting Haworth's accepted term "style-table" for "stigma-disk," which is in contradiction to Mr. Corry's own views; I have also replaced "anther-loculus" by "anther-cell," as more familiar to all English descriptive botanists.—W. T. THISELTON DYER.]

DESCRIPTION OF THE PLATES.

Lettering applicable to figs. 1–12 :—

a. upper end of free part of style.
a.l. anther-alæ.
an. anthers.
a.s. lateral processes of anthers giving rise to gynandrous union.
a.f. alar fissure.
an. lo. anther-cell.
c. cucullus, or nectary.
carp. carpel.
col. staminal column.
con. connective.
con.tis. conducting tissue.
corp. corpusculum.
c.f. corpuscular furrow.
corp.ap. corpuscular appendages.
el. space between adjacent anther-filaments.
f.v.b. fibro-vascular bundle of style.
gr. lateral grooves continuous at a lower level with space *el.*
h. horn springing from nectary.
k. notch in anther-ala.
lap. lamina at apex of connective.
m.m. fleshy teeth.
ov. ovules.
ova. ovary.
p. petal.
par. parenchyma of anther.
pl. placenta.
pol. pollinium.
r. radial groove.
recep. receptacle.
s. sepal.
s.t. style-table.
stig. receptive or stigmatic tissue.
sty. free portion of style.
tap. tapetum.
v. fibro-vascular bundle of stamen.
x. "canal of style."

PLATE XXIV.

Fig. 1. A fully expanded flower, with reflexed calyx and corolla, and exserted staminal column and corona.

Fig. 2. One of the nectaries of the staminal corona, seen from the side.

Fig. 3. The same: front view of the internal side.

Fig. 4. The same in longitudinal section, in order to show the origin of the horn-shaped process, *h*, from its base.

Fig. 5. Exserted portion of an expanded flower, showing the staminal column and the parts which it bears. *c.* Nectary, of which a portion has been cut away. *an., an.* Two anthers and portions of two more shown. *corp.* Two stigmatic corpuscles, one facing. *a.f., a.f.* Alar fissures; *a.l.* the boundaries of these; *k.* the notch near the lower extremity.

Fig. 6. Staminal column, seen from above.

Fig. 7. A stamen with its nectary cut, viewed dorsally.

Fig. 8. Adult expanded flower bisected longitudinally; the sepals, *s*, and petals, *p*, have been partially removed by section. The plane of section passes on the left side between two anther-alæ down

an alar fissure so that the corpusculum is cut vertically in half, and on the right side through a nectary slightly to one side of its middle. *a.s.* The lateral process of the anther united with the style-table. *stig.* The part of the stigmatic tissue which is exposed. *r.* The radial groove on the apex of the column.

Fig. 9. Nearly adult flower. Transverse section through the tissue of the staminal column a short distance above the origin of the nectaries, *c*, and below the point where the lower ends of the contiguous anther-alæ arise and begin to diverge from it. For description *vide* p. 181 of the text. *el.* Ellipsoid space there referred to.

Fig. 10. Transverse section through the tissue of the staminal column slightly above the preceding, and in the region where the lower ends of the anther-alæ diverge from it. For description *vide* p. 181 of text.

Plates XXV. & XXVI.

Fig. 11. Transverse section in part of the region of the apex of the column, showing how the radial groove, *r*, is formed by which the truly receptive surface, *stig.*, on the base of the style-table is exposed to receive the pollen-tubes when the pollinium ruptures. *Vide* p. 182 of the text.

The tapetal membrane, *tap.*, is represented as in its last phase previous to complete disappearance. The pollinia have fallen out of the anther-cells, *an.lo.* *par.* Parenchymatous tissue of the anther surrounding the anther-cells, which is subsequently absorbed when it dehisces. One of the styles (*sty.*) is represented in transverse section near its upper termination in the style-table by which it is surrounded; *f.v.b.*, its fibro-vascular bundle; *con. tis.*, the conducting-tissue on its inner side; *x.*, position of the "canal of the style."

Fig. 12. Transverse section through the gynostegium in the region of the extreme apex of the styles. In the section next above this the conducting-tissue, *con. tis.*, becomes continuous with that of the receptive surface. *a.s.* The lateral processes of the sides of the anthers forming the gynandrous union in this region; the bases of the anthers are free from the style-table.

Fig. 13. The section passes in the median longitudinal line of an alar fissure. *b.* Median part of the style-table, corresponding to the tissue internal to the fibro-vascular bundle in each of the two halves which fused to form it. *c.* External surface of style-table in contact on either side of the section with the anthers, and covered by a layer of epidermis. *d.* Parenchymatous tissue forming the bulk of the style-table. *e.* The receptive surface formed by the conducting-tissue, which is exposed by means of the open radial furrow, *m.* *f.* The upper part of a style. *g.* Its conducting-tissue. *h.* The fibro-vascular bundle, continuous from the free portion of the style into the style-table. *i.* The upper end of the staminal column in the median longitudinal line of the alar fissure. *k.* The epidermis of the outer and inner surfaces continuous with each other.

Development and Structure of the Corpusculum.

Fig. 14. Transverse section of a corpuscular furrow on one of the angles of the style-table, with the two quadrant-shaped masses of gum excreted by the papilliform cells lining its sides; they have become partially solid. The cells forming the floor of the groove have not yet begun to excrete. *Vide* p. 177 of text.

Fig. 15. The same at a later stage. The furrow has become deeper by the growing out of its sides, cell-division with growth occurring in the cells of its base. The two masses of gum of the previous stage have been in consequence carried upwards to the mouth of the furrow attached to the cells which excreted them. In consequence of additional exudations from behind they have

increased greatly in size, while they have at the same time been rotated through an angle of 45°. They now project over the furrow, and the portions of them which were formed in the previous stage have dried still more, and become of a darker colour.

Fig. 16. Front view of a removed corpusculum where union of the two lateral halves below is just beginning at the apex, owing to excretions from the floor of the furrow in that region. *corp. ap.* Its appendages, which exhibit the appearance of perforated sheets of pale-yellow gum, except in the middle line of each; this latter part is formed by the hollow of the lateral groove, and not by its margins; it is slightly darker in colour than the rest.

Fig. 17. Longitudinal section of a portion of the style-table in a plane through one of the anther-cells, showing one of the lateral diverging grooves, *l.g.*, the cells of which excrete the gum forming the corpuscular appendage, *corp. ap.* Owing to the method of its formation, this last-named body is thickest in the middle part, while its lateral margins still exhibit the impressions of the underlying excreting-cells.

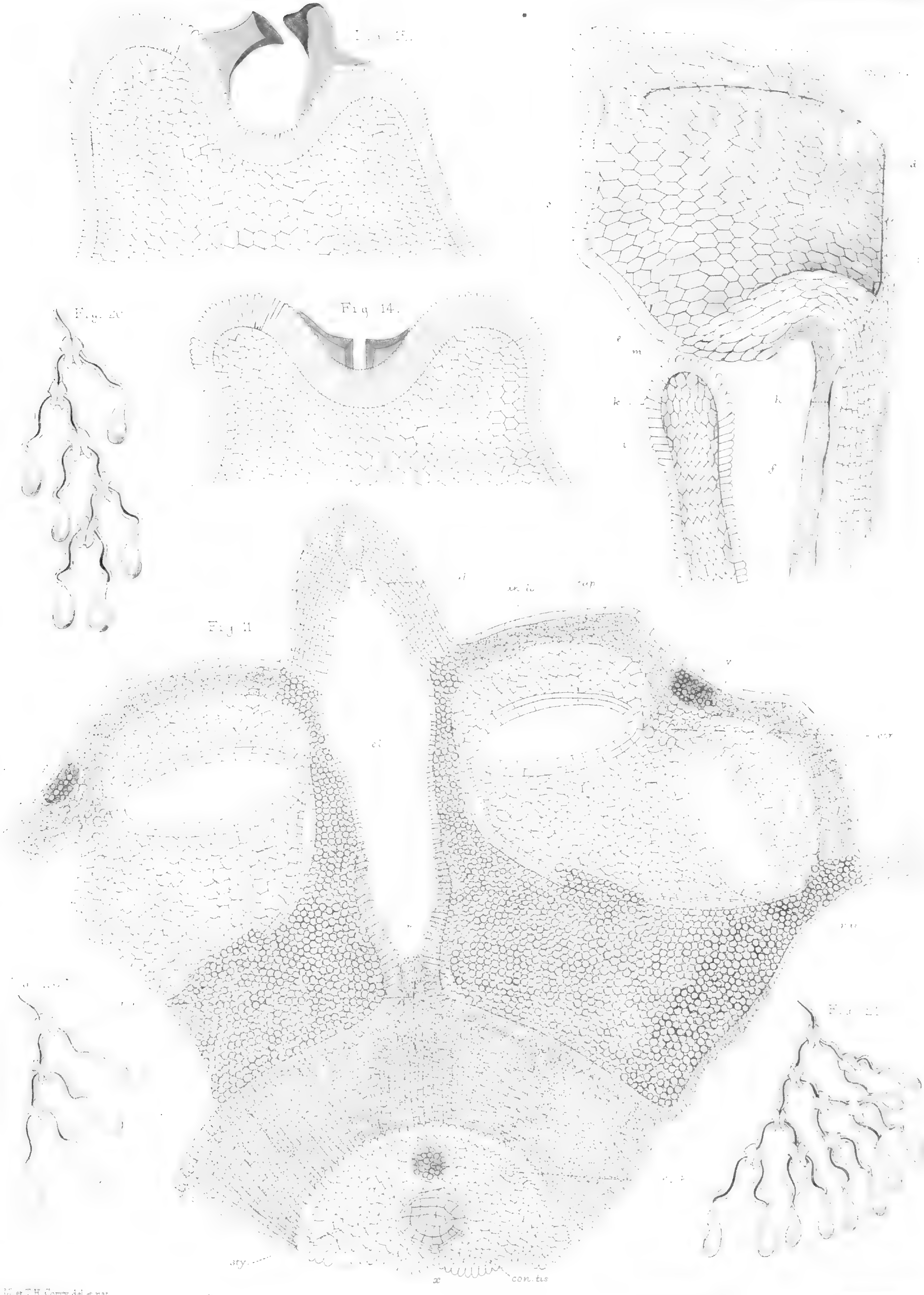
Fig. 18. Transverse section through a nearly adult corpusculum and the cells of the style-table, *s.t.*, which excrete it, forming, *c.f.*, the corpuscular furrow near the base of the corpusculum, on one side below the attachment of the appendage, on the other side at the lower end of this junction. *corp.* Corpusculum, the striations in which are indications of the ends of the papilliform cells which excreted it, and the ends of which still project slightly into its more liquid portion. The projecting anterior margins which were first formed have dried most completely, and are darkest; then the internal surface, while the exterior is still in the condition of yellow, only partially hardened gum.

The lateral grooves, *l.g.*, which excrete the "appendages," are also seen with their still semi-liquid exudations, *corp. ap.*, whose under-surface exhibits, where it has been raised, the imprint of the underlying cells.

Fig. 19. Adult corpusculum, *corp.*, its appendages, *corp. ap.*, and pollinia, *pol.*, attached to pulvillus of a fly's leg. Front view.

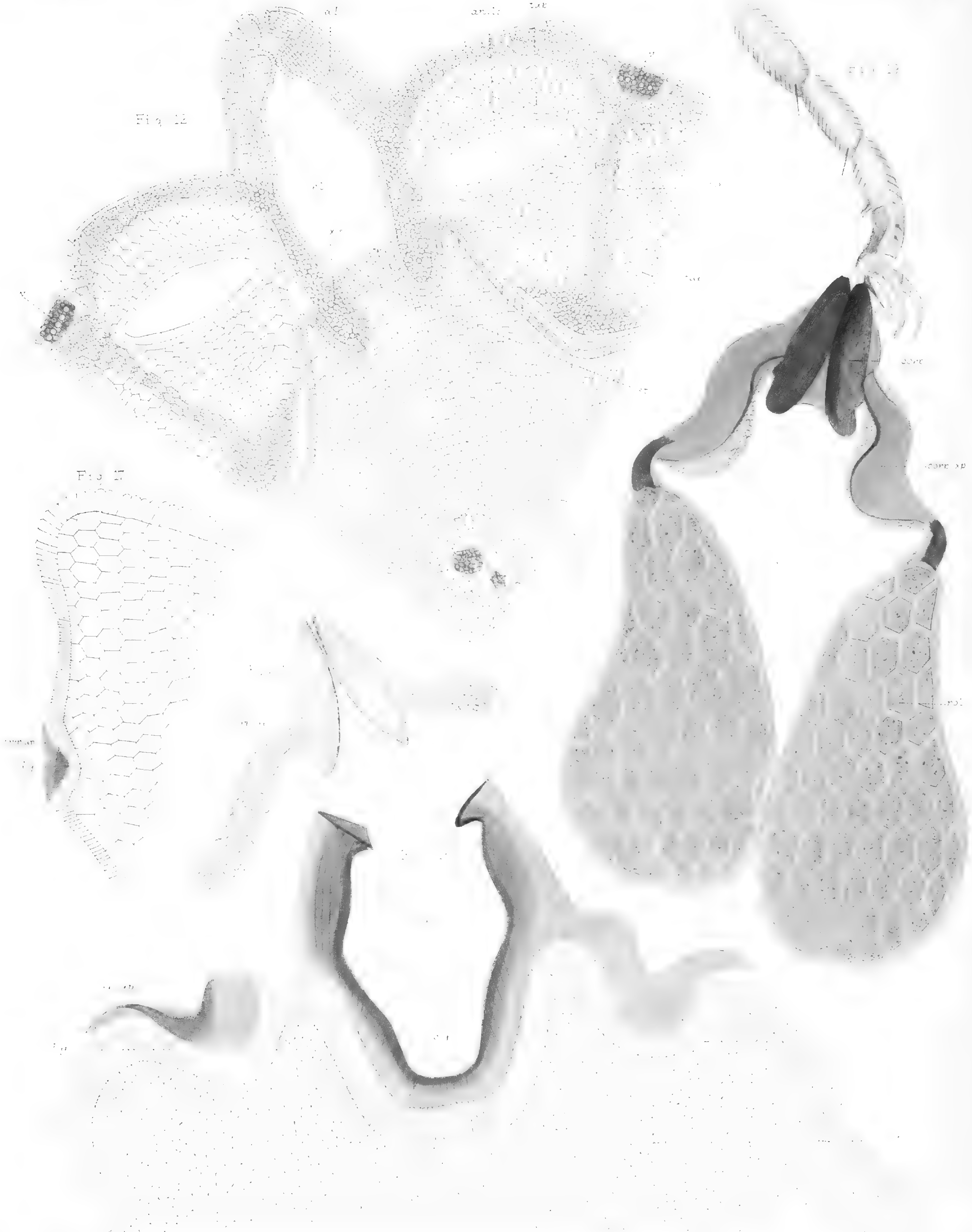
Figs. 20 & 21. Combinations of corpuscula with each other: Fig. 20. Unilateral or row-combinations; Fig. 21. Dichotomous combination.


Fig. 1
Fig. 9
Fig. 6
Fig. 2
Fig. 3
Fig. 5
Fig. 4
Fig. 7



H. M. et T. H. Corry del. et nat.

STRUCTURE CORPUSCULA OF ASCLEPIAS



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W. Ehrens lith.

STRUCTURE CORPUSCULA OF ASCLEPIAS CORNUTI

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	Part VI.	1884.	0	13	6	0	10	0
	Part VII.	1884.	0	9	6	0	7	0
	Part VIII.	1884.	0	10	0	0	7	6

2nd Ser. BOTANY.] [VOL. II. PART 9.

THE

TRANSACTIONS

OF

THE LINNEAN SOCIETY OF LONDON.

ON THE CASTILLOA ELASTICA OF CERVANTES,

AND SOME

ALLIED RUBBER-YIELDING PLANTS.

BY

SIR J. D. HOOKER, K.C.S.I., C.B., F.R.S., F.L.S.

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August 1886.

X. *On the* Castilloa elastica *of Cervantes, and some allied Rubber-yielding Plants.*

By Sir J. D. HOOKER, *K.C.S.I., C.B., F.R.S., F.L.S.*

(Plates XXVII. & XXVIII.)

Read December 3rd, 1885.

THE great importance of the India-rubber trade renders it necessary that the plants yielding this valuable product should be known with scientific accuracy. Of these, the Ule, that which yields the rubber of Mexico and Central America (*Castilloa elastica*), is the earliest described, and might hence be supposed to be well known. It is the purport of this communication to show that this is not so, and that probably more than one rubber-bearing species of that genus exists in Central America under this name.

Attention was first called to this subject by the receipt at Kew, from Dr. Trimen, Director of the Ceylon Botanical Gardens, of a specimen and a drawing—with complete analysis of the flowers and fruit—of the plant sent out from Kew in 1876 as *Castilloa elastica*, and which drawing differed considerably from Cervantes's figure and description of the Ule of Mexico. The tree from which the specimens were taken and drawing made, was raised from one of the cuttings procured in Darien (Panama) by Mr. Cross in 1875, and which, after being grown on at Kew, were distributed to various tropical Colonies, as detailed in Mr. Thiselton Dyer's account of Mr. Cross's mission and of the introduction into Europe of the India-rubber plant which is appended to this communication. It will be seen from that account that Mr. Cross sent the plant under the name Caucho, and that the locality where he procured it, the forests of the rivers Chagres and Gatun (well-known localities for India-rubber collectors) is considerably to the south of the botanically ascertained stations for the Ule. In selecting these forests for the purpose of collecting seeds Mr. Cross was, no doubt, indebted to information obtained by the late Mr. Sutton Hayes of Panama, and which is attached to specimens of an Ule, which latter, however, he procured from the Republic of San Salvador; and for assuming that the Caucho is the Ule or *Castilloa elastica* of Cervantes, he probably relied on the testimony of Cavanilles, who, in a notice of the Caucho of Darien (Panama) in the Ann. de Hist. Nat. Madrid, ii. p. 126, regards it as the same with the Ule of Cervantes, whose description he quotes at full length. Unfortunately Mr. Cross sent no other herbarium specimens of the Caucho than some very badly preserved old leaves and seeds, so that, until the arrival of Dr. Trimen's materials, the means of identification were wanting.

I have next to advert to specimens of the fruits of three forms or species of *Castilloa* from the forests of Honduras, preserved in fluid, kindly procured by W. H. Langton, Esq., Secretary of the Belize Estate and Produce Company; two of these are named Ule, and both stated to yield the Honduras rubber; the third is named Tunu, and said to yield a gutta-percha. I have given figures of all these in Plate XXVIII. These all differ more or less from the Caucho of Darien, collected by Mr. Cross, and one of them may, I think, be safely referred to the *C. elastica* of Cervantes. Unfortunately only one of them is accompanied with specimens of foliage, which, however, is that of the fruit which I attribute to *C. elastica*, and it further agrees with that of Mexican specimens of Ule. The other materials at Kew referable to *Castilloa* consist of:—flowers and leaves of the Ule from Mexico, collected by Ervendberg, Schiede and Deppe, and by Bourgeau; leaves of the Honduras Ule from D. Morris, Esq.; of the Nicaraguan Ule collected by P. Levy, and named var. *Costa-ricensis*, Bureau; San Salvador specimens of foliage and dried fruit from Mr. Sutton Hayes; flowering branches from Guatemala, collected by Fredericsthal; and leaves and flowers of the Jeve from the plains near Guyaquil, sent by Spruce as *C. elastica*.

These herbarium specimens present no characters of habit, foliage, or flowers to distinguish them from *C. elastica*: all the branchlets are clothed densely with substrigose buff-coloured hairs; the leaves are scabrid above, and densely hirsute or hirsutely tomentose beneath. On the other hand Cross's indigenous specimens of Caucho, and those cultivated in Ceylon, have the branchlets less clothed with hairs, and the under surface of the leaves less thickly tomentose.

Turning to the fruits in fluid, to the figure from Dr. Trimen, and to that accompanying Cervantes' account of Ule, these all agree in consisting of a fleshy circular disk, 1-3 inches in diameter, clothed beneath and on the circumference with densely imbricating triangular scales, and bearing on the upper surface 8–30 confluent orange-red, thick, coriaceous, one-seeded carpels, with more or less prominent pyramidal crowns. These carpels present important differences, possibly specific; but from the materials available it is not possible to determine what may constitute a species amongst them, and I shall therefore confine myself to defining the typical *C. elastica* more exactly than has hitherto been done, and follow this by descriptions of the forms allied to it.

I. Castilloa elastica*, *Cervantes, in Gaz. Litt. Mexic.* 1794 (*translated in Tracts relative to Botany, London*, 1805, p. 235, t. 9): ramulis crassis strigoso-hirsutis, foliis amplis breviter petiolatis bifariis oblongis v. obovato-oblongis abrupte acutatis basi cordatis integerrimis v. apicem versus denticulatis supra scabridis subtus dense hirsutis tomentosisve, nervis utrinque 17–21, stipulis 2–3-pollicaribus deciduis, receptaculis axillaribus turbinatis bracteis triangularibus persistentibus imbricatis tectis, ♂ breviter pedunculatis, ♀ subsessilibus, floribus ♂ achlamydeis densissime confertis, staminibus (floribus singulis?) bracteolis immixtis, fl. ♀ perianthiis ovoideis infra medium connatis ore minute 3–4-lobo, receptaculo fructifero disciformi crasso, basi margineque bracteis imbricatis appressis densissime tecto, carpellis maturis carnosis infra medium connatis superne liberis pyramidatis minute pubescentibus, parte libera 3-4-sulcata angulis rotundatis apice depressa 3–4-loba. —*Cavanilles, in Ann. des Hist. Nat. Madrid* (1800), ii. p. 126; *Trécul, in Ann.*

* Published anonymously, but known to be by Chas. Kœnig, F.R.S., Keeper of the Mineralogical Department of the British Museum.

Sc. Nat. sér. 3, viii. 136, t. 5. fig. 142–148; *Ramon de la Sagra, Flora cubensis*, iii. p. 223; *Collins, Report on Caoutchoucs of Commerce* (1872), p. 11, t. 2; *Hemsley, Biol. Centr.-Amer.* (*Botany*), iii. p. 149; *Morris, Colony of British Honduras* (1883), p. 75, *cum ic. xyl.*—C. costa-ricensis, *Liebman, K. Dansk. Vidensk. Selsk. Skrift.* ser. 5, p. 319; *Mexicos og Central Americas Neldeaglige Planter* (1851), pp. 34, 35; *Hemsley. l. c.* (Plate XXVIII. figs. 1–3.)

Hab. Mexico, from lat. 21° southwards; Guatemala; Honduras; San Salvador; Costa-Rica and Nicaragua, in low forests.

A lofty deciduous tree with milky juice; trunk 8–12 ft. in circumference; bark smooth, soft; branchlets very stout, with large pith and brown bark, extremities densely clothed with long fulvous hairs. *Leaves* 12–18 by 4–7 in., alternate and bifarious, firmly membranous, broadly oblong or obovate-oblong, abruptly acuminate, base cordate, entire or obscurely toothed at the tip, margin with minute tufts of hairs, scabrid above, beneath densely clothed with tawny hairs, midrib prominent beneath; nerves 17–21 pairs; petiole $\frac{1}{3}$–1 in., stout; stipules 2–3 in., clothed with tawny hairs, deciduous. *Flowers* monœcious, contained in solitary, axillary, turbinate, fleshy receptacles $\frac{1}{4}$–1 in. in diam., clothed outwardly with minute, densely imbricate, triangular, appressed, puberulous bracts. *Staminate receptacles* $\frac{3}{4}$–$1\frac{1}{2}$ in. in diam., shortly stalked, usually subcompressed, cup-shaped at the top, and covered densely with stamens mixed with bracteoles which do not overtop the margins of the cup. *Pistillate receptacles* similar, but rather smaller, and subsessile; flowers confluent; perianth fleshy, greenish, limb minutely 3–4-toothed; ovary immersed in the disk; styles 2, rarely 3. *Fruiting receptacle* (in Honduras specimens) $1\frac{1}{4}$–2 in. in diam.; ripe carpels coriaceously fleshy, with pyramidal free pubescent crowns $\frac{1}{3}$ in. high; crown 3–4-grooved laterally, with rounded angles and obtuse depressed 4-lobed tips. *Seeds* $\frac{1}{4}$–$\frac{1}{3}$ in. in diam.; more or less immersed in the free crown of the carpel; testa white, papery when dry; cotyledons thick, plano-convex, radicle minute, superior.

The character by which I identify this with the plant of Cervantes is that of the free part of the ripe carpels, which that author describes as "apice excavato;" in all the other forms noticed below these crowns are acutely 3–4-angled with acute tips. The reduced figure of the fruit given by Cervantes shows the character of the grooved sides and rounded angles of the carpels, but not their indented tips.

Trécul gives Cuba as a native country for *C. elastica*, on Ramon de la Sagra's authority, but a reference to the latter author's 'Flora Cubensis' shows that it is known in that island only in the Botanical Gardens of Havana.

II. The Caucho, or Darien plant. Leaves less thickly tomentose beneath. Fruiting receptacles 2–3 in. in diam.; crowns of the ripe carpels prominent, pyramidal, acute, acutely 3–4-angled. Seed $\frac{1}{3}$ in. in diam., more or less immersed in the free crown of the carpel.—Darien on the Chagres and Gatun Rivers.—*C. Markhamiana*, Markham (not of Collins), Peruvian Bark (1880), p. 453 *. (Plate XXVII. figs. 1–17.)

* *C. Markhamiana*, Collins, 'Report on the Caoutchouc of Commerce.' p. 12, t. 3, is no doubt correctly referred by Bentham, Gen. Pl. iii. p. 372, to *Perebea*.

III. Fruit referred to Ule from the Belize Estate and Produce Company.—Fruiting receptacle 1–$1\frac{1}{4}$ in. in diameter; crowns of the ripe carpels prominent, acute, acutely 3–4-angled. Seeds $\frac{1}{4}$ in. in diam., more or less immersed in the free crown of the carpel.—Honduras and Nicaragua. This appears to be a small seeded variety of the Darien species. (Plate XXVIII. figs. 4–6.)

IV. Fruit of the Tunu, or gutta-percha yielding plant, from the Belize Estate and Produce Company.—Fruiting receptacles 2–$2\frac{1}{2}$ in. in diam.; crowns of ripe carpels very low, subacute, acutely 3–4-angled. Seeds $\frac{1}{3}$ in. in diam., immersed in the receptacle far below the crowns of the carpels.—Spanish Honduras. (Plate XXVIII. figs. 7–9.)

Before dismissing the subject, it may be well to allude to the remarks made by Mr. Cross on the formation of disarticulating branches on the young plants of the Caucho, and which, no doubt, occur in other species of *Castilloa*. They are thus described by Mr. Cross in a letter dated April 26, 1877:—“In the forests the young *Castilloa* plants push up rank stems rapidly to a great height, which, during the progress of growth, throw out at variable distances a number of leafy shoots. These, on becoming mature, begin to wither, and finally separate from the surface of the trunk by an articulated or jointed process. I did not consider them true branches, just because the wood was not properly formed, the buds were imperfectly developed, and I found they were not easily propagated. It may be different with shoots developed by compressed pot culture. But when the tree begins to flower, true branches are formed which do not drop off. At times the trunk, after running up to a certain height, divides into two or three stems, each furnished with numerous short, stiff, upright branches, which are permanent, and ripen fruit abundantly. Probably, however, the description of shoots alluded to are produced at times during the entire period of the growth of the tree. A similar phase of growth appears to take place with other species of forest trees in the hotter parts of America.”

The above information is given in abstract by Mr. Lynch, Curator of the Cambridge Botanic Garden, with due reference to its author, in his interesting paper “On the Disarticulation of Branches,” published in the 16th volume of our Journal (p. 182), accompanied by an excellent drawing of the phenomenon, and the observation that the deciduous branches strike under cultivation as freely as the permanent ones. The figure of Cervantes shows a contraction at the base of the branches, where disarticulation would occur.—J. D. HOOKER.

IN the summer of 1875 the India Office despatched Mr. R. Cross (who, in 1860, had accompanied Dr. Spruce in his expedition to Ecuador to collect plants of *Cinchona* *succirubra)* to Darien to obtain seeds and plants of *Castilloa elastica* *. This mission he successfully accomplished. He reported as follows (August 4, 1875) to C. R. Markham, Esq., C.B.:—

"By this mail I have despatched (addressed to the Under Secretary of State for India) a small bag containing upwards of 7000 seeds of the Caucho tree which I have just collected in the centre of Darien. There is only *one* species, the difference being in those growing in the shade or exposed. The seeds were collected in good condition and perfectly ripe, but from observations on a few gathered on first arrival they do not appear to keep well, containing, even when mature, a milky juice.

* * * * * * * * * *

"The interior of the Darien forests would frighten most people. The undergrowth is composed of boundless thickets of a prickly-leaved species of *Bromelia* often 8 to 10 ft. high, the ground swarms with millions of ants, and the snakes raise themselves to strike at any one who approaches.

"The Caucho tree grows not in inundated lands or marshes, but in moist undulating or flat situations, often by the banks of streamlets, and on hill sides and summits where is any loose stone and a little soil. It is adapted for the hottest parts of India, where the temperature does not fall much below 74° Fahr. The tree is of rapid growth, and attains to a great size, and I am convinced that when cultivated in India it will answer the most sanguine expectations that may have been formed concerning it. I have been up the Chagres and Gatun rivers. I came out on the railway about 7 miles from Colon. I go back to the same place (the village of Gatun), from which place by the river the India-rubber forests are reached."

As stated in the Kew Report for 1875 (p. 8), Mr. Cross's expectations as regards the seeds were realized. The whole parcel failed to germinate. Mr. Cross, however, with considerable difficulty, and after undergoing shipwreck †, succeeded in bringing safely to Kew (Oct. 3) a considerable collection of cuttings from which a supply of plants was raised. Of these, two plants were despatched to Dr. Thwaites, Director of the Royal Botanic Gardens, Peradeniya, Ceylon, April 27, 1876, and thirty-one on August 9 following. Of these last, twenty-eight arrived alive (Kew Report, 1876, p. 9).

A further consignment of twenty-four plants was sent, Sept. 15, 1877, to Dr. Thwaites, who meanwhile had been establishing the former consignment in the tropical garden at Heneratgodde (Kew Report, 1877, p. 16). Here they made satisfactory progress, Mr. Morris describing them, May 18, 1878, as growing "into broad spreading trees with a very majestic air." Dr. Thwaites, however, met with great difficulty—contrary to the Kew experience—in propagating the tree by cuttings (Kew Report, 1878, p. 14).

In 1880 Dr. Trimen, who had succeeded Dr. Thwaites as Director of the Royal Botanic Gardens, Peradeniya, reported. "Much better success now attends the propagation by cuttings of this fine species. Our largest trees at Heneratgodde have now a

* See also Mr. Markham's account of the enterprise in 'Peruvian Bark' (London, 1880), pp. 452–454.

† Markham, *l. c.* p. 453.

circumference of nearly seventeen inches at a yard from the ground, and the trees are beginning to take their true form." (Kew Report, 1880, p. 17.)

In the following year Dr. Trimen reported, "The Castilloa, both at Peradeniya and Heneratgodde, produced flowers during the dry weather of April; on examination, however, these were all male. This species is said not to produce seed till eight years old. The finest tree at Heneratgodde has now a stem of 22½ inches in circumference at about a yard from the ground." (Kew Report, 1881, p. 13.)

Dr. Trimen further reported, Oct. 20, 1882, "We have some sturdy little seedlings of Castilloa coming on from our seed. Only three fruits ripened in June, and the fifteen seeds from these were sown at once, and germinated in fifteen days." (Kew Report, 1882, p. 22.)

It is not necessary to pursue the history of the introduction into the East Indies beyond the appearance of a new seminal generation. It will be sufficient to quote from the Kew Report for 1882, p. 40, the account of the first sample of Caoutchouc obtained from the *Castilloa* under cultivation in the Old World.

"In October 1882, the Director of the Royal Botanic Gardens, Peradeniya, Dr. Trimen, forwarded to Kew a sample of the rubber of *Castilloa elastica* grown in the Experimental Gardens at Heneratgodde, Ceylon. This was sent from Kew in 1876 (*see* Kew Report, 1876, p. 9). The sample was submitted to S.W. Silver, Esq., F.L.S., who very kindly reported upon it:—'On working and drying a portion of this sample, the loss is 12·3 per cent.; it is necessary to use warm water in washing this rubber; it becomes on drying much darker and shorter than Para rubber. It has a bitter taste, which is not removed on washing. The unwashed sample yields 1·9 per cent. ash, the washed sample gives 1·2 per cent. The shortness of this rubber would restrict its use to some extent where tensile strength or tenacity is required.' It was valued, Dec. 8, 1882, as worth 2*s*. 9*d*. to 3*s*. per pound."

It remains to add that the Darien *Castilloa* has been successfully introduced by plants sent from Kew into Liberia and the Cameroons River on the west coast of Africa, and into Zanzibar and the Mauritius on the east; also into Singapore, Java, Jamaica, and Granada. From Ceylon plants have been sent to Calcutta, Burma, and Madras, and from Singapore to Perak and Queensland.—W. THISELTON DYER.

DESCRIPTION OF THE PLATES.

PLATE XXVII.

Figs. 1–17. Caucho of Darien, from the Ceylon Botanic Garden. 1, leaf; 2, male, and 3, female branches: *of the natural size*;—4, portion of leaf, *enlarged*;—5 & 6, vertical sections of male receptacle; 7 & 8, stamens: *all enlarged*;—9, vertical section of female flowering-receptacle, *of the natural size*;—10, single carpel; 11, vertical section of two carpels: *all enlarged*;—12, fruiting-receptacle; 13, single carpel from ditto; 14, seed; 15, embryo; 16, transverse section of ditto; 17, single cotyledon and plumule: *all of natural size*.

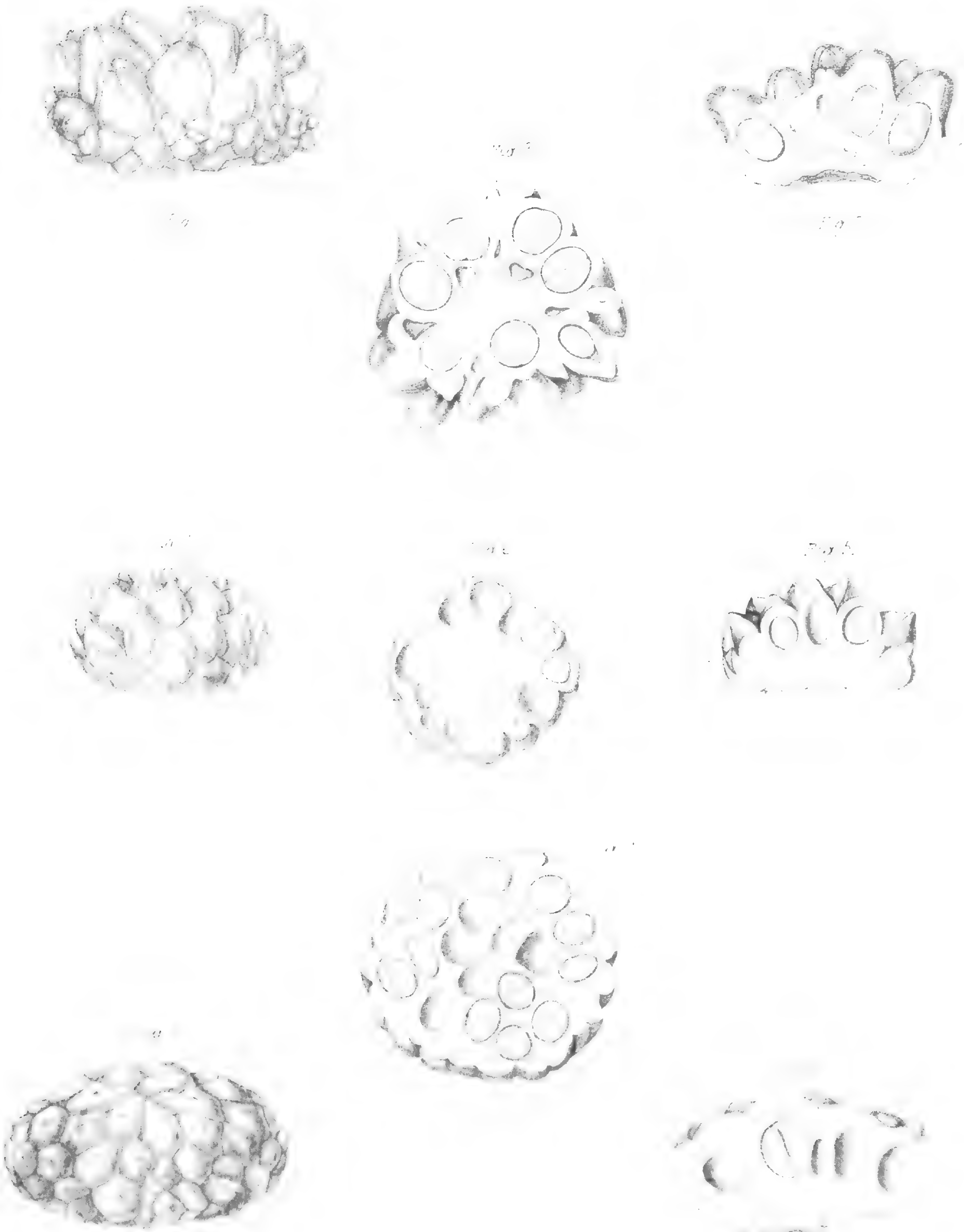
Plate XXVIII.

Figs. 1–3. Fruiting-receptacle of *Castilloa elastica* from Honduras; 1, 2, & 3, vertical and horizontal sections of ditto: *all of the natural size.*

Figs. 4–6: 4, fruiting-receptacle of a *Castilloa* from Honduras, probably the same species as the preceding; 5 & 6, vertical and horizontal transverse sections of ditto: *all of the natural size.*

Figs. 7–9: 7, fruiting-receptacle of the Tunu of Honduras; 8 & 9, vertical and horizontal transverse sections: *all of the natural size.*

Trans. Linn. Soc. Ser. 2 Bot. Vol. II. Pl. 27.



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	Part VIII.	1883.	0	3	0	0	2	3
	Part IX.	1883.	0	3	0	0	2	3
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	Part XIII.	1884.	0	6	0	0	4	6
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	Part V.	1878.	1	4	0	0	18	0
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	Part VIII.	1880.	1	1	0	0	16	0
	Part IX.	1880.	1	0	0	0	15	0
II.	Part I.	1881.	0	12	0	0	9	0
	Part II.	1882.	0	5	0	0	3	9
	Part III.	1883.	0	10	0	0	7	6
	Part IV.	1883.	0	3	0	0	2	3
	Part V.	1883.	0	3	0	0	2	3
	Part VI.	1884.	0	13	6	0	10	0
	Part VII.	1884.	0	9	6	0	7	0
	Part VIII.	1884.	0	10	0	0	7	6
	Part IX.	1886.	0	7	0	0	5	0

2nd Ser. BOTANY.] [VOL. II. PART 10.

THE TRANSACTIONS OF THE LINNEAN SOCIETY OF LONDON.

LIST OF FUNGI FROM QUEENSLAND AND OTHER PARTS OF AUSTRALIA; WITH DESCRIPTIONS OF NEW SPECIES.—PART III.

BY

THE REV. M. J. BERKELEY, M.A., F.R.S., F.L.S., and C. E. BROOME, M.A., F.L.S.

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April 1887.

XI. *List of Fungi from Queensland and other parts of Australia; with Descriptions of New Species.*—Part III. *By the* Rev. M. J. Berkeley, *M.A., F.R.S., F.L.S., and* C. E. Broome, *M.A., F.L.S.*

(Plate XXIX.; Plate XXX. is cancelled.)

Read 15th April, 1886.

THE present list of Fungi from Queensland and other parts of Australia is supplementary to that given in Series 2, vol. ii. of the 'Linnean Transactions,' pp. 53–73, March 1883. They were collected by F. M. Bailey, Miss F. Campbell, of Melbourne, Mr. Tryon, Mr. Mitkin, of the Johnston River, Mr. Thomas Wright, and others. It begins with No. 274 (continued from the former list) and extends to No. 360. We are compelled to omit several specimens of the *Agaricini*, owing to the absence of notes and coloured figures, without which it is impossible to determine species belonging to that Order with any degree of certainty. A number of leaf-fungi have also been sent to us; some of these are merely the work of gall-insects, others are resinous exudations, and of the rest many are immature or otherwise imperfect; among these contributions several of considerable interest occur, as *Mesophellia arenaria*, Berk., which is found dug up (apparently for food) by the Bandicoots, and left scattered about on the surface of the ground; *Podaxon carcinomalis*, Fr., found on ant-hills; and two species of hypogæous fungi. There is little doubt that a great deal remains to be done among these Orders in so vast a country as Australia, and we may look for great results from those engaged in their investigation; especially we have great hopes from our new correspondent Miss F. Campbell, of Melbourne, for as we get further south we may expect to meet with those fungi which require a moister and cooler climate than that of Queensland, and of this we have evidence in the hypogæous species alluded to above, one of which is a form common in South Europe.

274. Agaricus (§ Amanita) ovoideus, Fr.

Differing from *A. virosus* in being edible (*Miss F. Campbell*, no. 165).

275. Agaricus (§ Lepiota) Brekleri, Berk., Fungi of Australia, Linn. Journ. xiii. p. 156.

276. Agaricus (§ Collybia) radicatus, Relhan. (*Miss F. Campbell*, nos. 173 and 181.)

277. Agaricus (§ Flammula) gymnopodius, Bull. (*Miss F. Campbell*, no. 163.)

278. Agaricus (§ Pleurotus) lignatilis, Pers.

It is impossible to determine *Agarici* with certainty without full notes and figures, but the specimen agrees very closely with the above (*Miss F. Campbell*, no. 85).

279. Agaricus (§ Crepidotus) interceptus, Berk., in Flora of Tasmania, ii. p. 246.

Agaricus (§ *Crepidotus*) *mollis*, Schæff., comes very near the specimen, but Miss Campbell describes it as "white," which would not be the case in that species if her plant were mature; it is therefore safer to refer it to *A. interceptus*, Berk., with the figure of which it agrees closely. The stem is much more developed in the latter. The spores were doubtful, as the specimen was covered with mould.

280. Cortinarius cinnabarinus, Fr. (*Miss F. Campbell*, no. 164.)

281. Lactarius quietus, Fr. (*Miss F. Campbell*, no. 192.)

This seems to be merely a pale variety of the species.

282. Russula rubra, Fr. So far as it is determinable (*Miss F. Campbell*, no. 185).

283. Lentinus lepideus, Fr. (*Miss F. Campbell*, no. 191.)

284. Lentinus cochleatus, Fr. (Plate XXIX. figs. 1–6.) A highly coloured pink form; probably a young stage (*Miss F. Campbell*, no. 190). This was found by her on the ground; but possibly it grew on wood buried in the earth.

285. Lentinus tigrinus, Fr. (*Miss F. Campbell*, no. 108.) The specimen is in very bad condition.

286. Lentinus cyathus, Berk. & Broome (*F. M. Bailey*, no. 456).

This was described before under no. 31, but it is now sent in a more perfect condition, growing on a large *Sclerotium*, from which it seems to be produced. *Lentinus descendens* is also described as proceeding from a tuberous base. A similar case is presented by *Polyporus tuberaster* the sclerotioid base of which is known as the "Pietra fungaia" of Micheli. The specimen was found by Mr. H. Schneider.

287. Lentinus Kurzianus, Currey, in Linn. Trans. 1876, 2nd ser. i. p. 120. (*F. M. Bailey*, no. 433.)

The specimen differs only from Kurz's in being rather larger, and the gills more distant. Kurz collected his specimens in Pegu.

288. Panus torulosus, Fr. (*Miss F. Campbell*, no. 83.)

289. Panus rivulosus, Berk., Australian Fungi, Linn. Journ. vol. xviii. p. 384. Brisbane (*F. M. Bailey*, no. 477).

290. Trogia crispa, Fr. (*Miss F. Campbell*, no. 114.)

291. Xerotus Archeri, Berk., in Flora of Tasmania, vol. ii. p. 250. The specimen is in bad condition, but it agrees generally with the above. (*Miss F. Campbell*, no. 86.)

292. Boletus edulis, Bull. On the authority of Miss F. Campbell, her no. 151.

293. Polyporus (§ Merisma) confluens, Fr. (*Miss F. Campbell*, nos. 94–98.)

294. Polyporus (§ Merisma) intybaceus, Fr.

The specimen is in very bad condition. Melbourne (*Miss F. Campbell*, no. 108 bis).

295. Polyporus (§ Merisma) acanthoides, Fr. (*Miss F. Campbell*, no. 100.)

296. Polyporus (§ Merisma) sulfureus, Fr. Brisbane (*F. M. Bailey*, no. 473).

297. Polyporus (§ Pleuropus) grammocephalus, Berk. One of the forms of this variable species, differing in its shorter stem and paler colour from the typical plant.

298. Polyporus (§ Anodermei) pelliculosus, Berk. Resembling *P. hispidus* in habit, but the flesh is white.

299. POLYPORUS (§ ANODERMEI) PLEBEIUS, Berk., in Flora of New Zealand, p. 179.

This species has been determined by Dr. Cooke after careful comparison with specimens in the Kew Herbarium. He has placed it among the *Inodermei*, but Mr. Berkeley thinks the specimen differs from *P. plebeius* in the pileus. (*Miss F. Campbell*, no. 125.)

300. POLYPORUS (§ ANODERMEI) PLEBEIUS, Berk.

A resupinate form. Brisbane (*F. M. Bailey*, no. 443).

301. POLYPORUS (§ ANODERMEI) PERGAMENUS, Fr. Brisbane (*F. M. Bailey*, no. 478).

302. POLYPORUS (§ PLACODERMEI) APPLANATUS, Fr. Brisbane (*F. M. Bailey*, no. 434).

303. POLYPORUS (§ PLACODERMEI) PECTINATUS, Kl. (Plate XXIX. fig. 7.)

There is some doubt if this plant be Klotzsch's species, but it comes nearer to it than to *P. conchatus*, Fr. (*F. M. Bailey*, no. 470), *Mr. James Keys*, Mount Perry.

304. POLYPORUS (§ INODERMEI) HIRSUTUS, Fr. (*Miss F. Campbell*, no. 95.)

305. POLYPORUS (§ RESUPINATI) VAPORARIUS, Fr. Brisbane (*F. M. Bailey*, nos. 450, 451).

306. TRAMETES SERPENS, Fr. Brisbane (*F. M. Bailey*, no. 472).

307. TRAMETES PERENNIS, Fr. (*Miss F. Campbell*, no. 144.)

308. HEXAGONIA DECIPIENS, Berk. (*Miss F. Campbell.*)

309. MERULIUS LACRYMANS, Fr. The specimen is thinner than usual, and the sinuses smaller. Brisbane (*F. M. Bailey*, no. 500).

310. FISTULINA HEPATICA, Fr. Brisbane (*F. M. Bailey*, no. 454).

311. HYDNUM MEMBRANACEUM, Bull. (*Miss F. Campbell*, no. 104.)

312. HYDNUM GRAVEOLENS, Delast.

313. HYDNUM TOMENTOSUM, Fr.

314. HYDNUM GELATINOSUM, Scop. This and the preceding two species were sent without any number by Miss F. Campbell.

315. PHLEBIA MERISMOIDES, Fr. Bunya Mountains, Brisbane (*F. M. Bailey*, no. 479).

316. CLADODERRIS DENDRITICA, Pers. (*Miss F. Campbell*, nos. 196, 198.)

317. STEREUM (§ MERISMA) ILLUDENS, Berk. (*Miss F. Campbell*, no. 197.)

318. THELEPHORA ———. An interesting species allied to *T. Sowerbii*, Berk., but sent in a bad state, and requiring further specimens for clear determination. (*Miss F. Campbell*, nos. 199 and 200.)

319. THELEPHORA PALMATA, Fr. Brisbane (*F. M. Bailey*, no. 460).

320. LACHNOCLADIUM SIMULANS, Berk. & Broome. (Plate XXIX. figs. 8 *a* and *b*.)

L. nigro-fuscum; stipite simplici; ramis tenuibus, apice furcatis superne divisis.

Black-brown when dry, tomentose; stem simple below, repeatedly branched above; branches slender, the tips furcate, acute. The whole plant $\frac{1}{2}$ to $\frac{3}{4}$ inch high, resembling some forms of *Thelephora anthocephala* in habit. Spores subglobose or ovate, 0·0003 to 0·0005 inch long. This plant would come under *Eriocladus* of Leveillé. Growing on the ground. We do not know what the colour is in a recent state, but it differs from

L. furcellatum, Lév., with which it accords in some respects in its dark brown colour when dry. Brisbane (*F. M. Bailey*, nos. 386 and 458).

321. CORTICIUM RHABARBARINUM, Berk. & Broome, Fungi of Ceylon, no. 627. Brisbane (*F. M. Bailey*, no number).

322. CYPHELLA SCHNEIDERI, Berk. & Broome. (Plate XXIX. fig. 9.) Brisbane (*F. M. Bailey*, no. 461). Tubæformis, membranacea, extus lævigata, pallide lutea.

This pretty and curious species was found by Mr. Schneider growing on wood in a crowded manner, 2 to 3 lines high; spores globose, 0·0002 to 0·0003 inch in diameter. Named after the discoverer, H. Schneider.

323. CLAVARIA AUREA, Fr. Tasmania (*Miss F. Campbell*, no. 29).

Miss Campbell says "colour as if dipped in port wine." When dry the plant becomes a dull yellow, brownish in places. Fries describes *C. aurea* as "non pure flava;" we may therefore regard the specimen as belonging to that species, as it resembles it in many points.

324. CLAVARIA FASTIGIATA, DC.

The specimens from Miss F. Campbell agree in habit with this species; the colour is said to be "canary-colour" or "white," and to grow "on branches." *C. fastigiata* is a terrestrial species. The specimens came in bad condition, but there seems to be nothing like them in those described as growing on wood. Melbourne (*Miss F. Campbell*, no. 91).

325. CLAVARIA RUGOSA, Bull.

So far as can be determined from dry specimens, *C. Archeri*, Berk., in 'Flora of Tasmania,' comes very near. (*F. M. Bailey*, no. 470.)

326. CLAVARIA ARCHERI, Berk., in Flora of Tasmania. Brisbane (*F. M. Bailey*, no. 469).

Clavaria rugosa, Bull, comes very near; the colour of the specimen is rather that of the above; when dry it is a dark buff.

327. TREMELLA FOLIACEA, Pers.? (*Miss F. Campbell*, no. 201.)

328. TREMELLA MICROSCOPICA, Berk. & Broome, n. sp. (Plate XXIX. figs. 10–14.) Minuta, hemisphærica, punctiformis, nigro-viridis, ad folia punctata.

This species forms dark green (black when dry) scattered spots on the upper surface of a dotted leaf; group undetermined. The spots are about $\frac{1}{50}$ inch in diameter. The threads are irregularly branched and septate, hyaline or very pale brown, terminated by ovate, apiculate, sometimes concatenate basidia, and in other parts by chains of globose spermatia; spores have not been seen. The basidia are about 0·0007 inch long by 0·0004 or 0·0005 across, the spermatia about 0·0002 in diameter. The leaf is labelled as having been obtained near Melbourne "in a damp hole on fallen leaves," but the plant or tree not specified (*Miss F. Campbell*, no. 201).

329. PODAXON CARCINOMALIS, Fr. (*F. M. Bailey*, sent without any number.)

330. MESOPHELLIA ARENARIA, Berk., Linn. Trans. xxii. p. 131, t. 25, C.

Miss Campbell says that this species is eaten by the Bandicoots; they scratch it up and leave it scattered about on the surface of the ground.

331. Tulostoma mammosum, Fr. Brisbane (*F. M. Bailey*, without any number).

332. Geaster australis, Berk., in Flora of Tasmania. Brisbane (*F. M. Bailey*, no. 441). The specimens resemble the figures in the above work.

333. Geaster fimbriatus, Fr. Sent without any number.

334. Bovista cervina, Berk. (*Miss F. Campbell*, no. 103.)

335. Scleroderma geaster, Fr. (*Miss F. Campbell*, no. 101, and no. 120 partim.)

The specimen appears to belong to this species.

336. Scleroderma bovista, Fr. (*Miss F. Campbell*, no. 120.)

337. Hymenogaster lycoperdineus, Vitt., Mon. Tuberacearum, p. 22, t. ii. fig. 5.

Miss F. Campbell describes this plant as "violet colour externally when fresh, turning brown in drying." It is bright ferruginous-brown within, spores elliptic ferruginous, ·013 to ·018 mm. long; the cells are large and irregular, their walls thin. In all these points it agrees so well with Tulasne's figures and description (Hypog. Fungi, p. 64, t. x. fig. v.) that we cannot consider it specifically distinct, although he does not mention the violet colour alluded to by Miss F. Campbell. Vittadini figures the spores as nearly globose and strongly apiculate, whereas Tulasne depicts them from an authentic specimen as smooth and elliptical, without any apiculus, which is exactly the case in those of Miss Campbell's plant. There is some confusion in Vittadini's figures.

338. Hydnangium australiense, Berk. & Broome, Linn. Trans. 2nd ser. vol. i. p. 66.

The spores are somewhat smaller than those in a specimen from Brisbane, probably they are not mature. Melbourne (*Miss F. Campbell*, no. 27 *b*).

339. Cladosporium oligocarpum, Corda, Icones i. p. 14, t. iv. fig. 208. Brisbane, on old *Polyporus portentosus*.

The specimen agrees generally with Corda's plant, of which we have no authentic specimen. The centre of the mass of threads is covered with the fallen spores, giving the plant an annular appearance. The circumference is formed of irregular black septate threads. Spores elliptic, about 0·0005 inch long. (*F. M. Bailey*, no. 446.)

340. Puccinia rumicis, Körnicke. (*F. M. Bailey* with no. 430.)

341. Antennaria Robinsonii, Berk. & Mont.

Imperfect, but so considered by Dr. Winter. Sent without a number.

342. Sphæropsis Eucalypti, Berk. & Broome, n. sp. (Plate XXIX. figs. 15–17.) S. peritheciis nigris, globosis, nitidis, in corpore sclerotioideo insidentibus; sporis linearibus, hyalinis.

The sclerotioid bodies are scattered thickly over the upper surface of the leaves of apparently a *Eucalyptus*, and are surmounted by four to seven black, globose, shining perithecia. The sclerotia are of a loose, spongy texture and pale brown internally. The spores are linear, hyaline, and about 0·001 inch long. This species appears to belong to Saccardo's section *Dothiorella* of the genus *Sphæropsis* (*Miss F. Campbell*, Melbourne, no. 203).

343. Leotia lubrica, Pers. (*Miss F. Campbell*, no. 156.)

344. Peziza (§ Geophyxis) aluticolor, Berk. (*F. M. Bailey*, no. 432.)

345. Peziza (§ Otidea) apophysata, Cooke & Phillips, Mycographia, fig. 350.

We have placed our plant under this species, as it agrees in every respect with Dr. Cooke's characters, except in the paraphyses which are unbranched, resembling those of *P. pleurota*, Phillips. Mr. Phillips, to whom the specimen was submitted, considers that the difference is not sufficient to constitute a new species. Melbourne (*Miss F. Campbell*, no. 123).

346. Tympanis toomansis, Berk. & Broome, n. sp. (Plate XXIX. figs. 18–21.) Erumpens, primo farinosa, sphæriæformis, dein stipitata, disco aperto cretaceo, margine incurvo.

This curious species occurred on the cones of some species of *Banksia*. It grows in a crowded manner, resembling at first an erumpent *Sphæria*, afterwards it develops a stem about 2 lines high, with an open chalky disk and an incurved margin. It is clothed externally with a chaffy, dirty white tomentum. The asci are immature; but a few ovate bodies resembling sporidia occur, they have not, however, been seen within the asci. The plant contracts much in drying, and the substance is very tough. We have placed it provisionally in *Tympanis*, as it resembles that genus in habit and consistence. It was found on the banks of the river Tooma. (*Miss F. Campbell*, no. 23.)

347. Hypomyces aurantius, Tul. Brisbane (*F. M. Bailey*, no. 476).

348. Hypomyces chrysospermus, Tul. Brisbane (*F. M. Bailey*, no. 449).

349. Xylaria hypoxylon, Grev. Melbourne (*Miss F. Campbell*, no. 28).

350. Hypoxylon Baileyi, Berk. & Broome (*Nummularia Baileyi*, Cooke). (Plate XXIX. figs. 22 & 23.) Erumpens, orbiculare, cupulatum; margine incrassato-elevato; disco ostiolis prominulis exasperato; peritheciis elliptico-ovatis, centro immersis; ascis cylindricis; sporidiis ellipticis, fuscis, ·013–·02 mm. longis. On wood, Brisbane (*F. M. Bailey*, no. 428). Cooke in Grevillea, xii. p. 6.

351. Hypoxylon flavo-fuscum, Berk. & Broome, n. sp. (Plate XXIX. figs. 24–27.) Convexum, flavo-fuscum, farinosum, ostiolis nigris, prominentibus punctatum, intus album.

Convex, irregularly lobed, of a red-brown colour, sprinkled with shining particles, dotted with the black, obtuse, prominent ostiola; from 2 to 3 lines across. Asci linear, containing 8 ovate, dark brown, smooth sporidia, 0·0007 to 0·0008 inch long, in a single row. This species seems to be nearly related to *H. pulchellum* and *H. commutatum*, Saccardo, Fungi Veneti, nos. 147 and 148; the former, however, grows on beech-wood, and the sporidia are boat-shaped, the latter on birch, with much longer and broadly fusiform fruit. This curious species grows on dead roots of grass. Brisbane (*F. M. Bailey*, no. 448).

352. Hypoxylon luteum, Fr. (*Miss F. Campbell*, no. 148.)

353. Dothidea Fimbristylis, Berk. & Broome. (Plate XXIX. figs. 28–30.) D. stromate nigro, epidermate tecto, ostiolis granulato.

It forms black, shining patches from $\frac{1}{10}$ to $\frac{1}{15}$ inch in length. Asci clavate; sporidia fusiform, curved, arranged in one or two rows, about 0·0007 inch long. Collected by Mr. C. Burton, at Northcote, Queensland. On some species of *Fimbristylis* (*F. M. Bailey*, no. 453).

354. SPHÆRIA (§ SUBTECTA) MACROZAMIÆ, Berk. & Broome. (Plate XXIX. figs. 31–35.) Perithecia immersa primo sparsa, denique conferta, nigra; ostiolis brevibus erumpentibus.

Seated beneath the cuticle, at first scattered, at length aggregated into a black mass, the perithecia surrounded by a subiculum of coarse, dark brown, branched threads. In the early stage the perithecia are conidiiferous, but later on asci occur, the conidia and sporidia being very similar. Perithecia at length collapsed and cup-shaped. On the fruit of a new species of *Macrozamia* from the Daintree River. Sporidia distinct, fusiform, about 0·0003 inch long. Brisbane (*F. M. Bailey*, no. 459).

355. SPHÆRIA (§ SUBTECTA) SACCHARI, Berk. & Broome. (Plate XXIX. figs. 36–39.) S. peritheciis sparsis vel aggregatis minutis, nigris, erumpentibus; ostiolis sublongis, acutis.

The perithecia occupy chiefly the spaces between the nerves of the leaves and are surrounded by dark-brown septate threads, the acute ostiola piercing the cuticle. Asci linear; sporidia 8, oblong, continuous, with a nucleus at either end, 0·0015 inch long. Apparently immature. On sugar-cane. Woodlands, Queensland (*William Broome*).

356. SPHÆRELLA LITSEÆ, Berk. & Broome, n. sp. (Plate XXIX. figs. 40–42.) Perithecia sparsa, nigra, ad maculas brunneas margine nigro circumdata.

The perithecia are rather prominent, black, seated on a pale brown spot, which is $\frac{1}{2}$ to $1\frac{1}{2}$ line across, they vary from 4 to 15 on each spot; asci clavate, containing 8 elliptic or fusiform, hyaline, continuous, 0·0013 inch long sporidia, sometimes in a double row. Brisbane (*F. M. Bailey*, sent without a number).

357. SPHÆRELLA DAMMARÆ, Berk. & Broome, n. sp. (Plate XXIX. figs. 43–45.) Perithecia nigra, innata denique erumpentia; ostiolis brevibus, obtusis, ad maculas pallidas, margine elevato, brunneo; ascis clavatis, sporidiis fusiformibus.

Spots very pale brown or yellowish, surrounded by a dark brown, raised margin, resin-coloured at first; perithecia black, at length piercing the cuticle with the short, black, obtuse ostiola; asci clavate; sporidia 8, fusiform, 0·007 inch long, apparently continuous, but perhaps immature. On leaves of *Dammara robusta*, C. Moore. Brisbane (*F. M. Bailey*, no. 482).

358. MELOGRAMMA RUBRICOSUM, Tul. (*F. M. Bailey*, no. 196, was probably the pycnidiophorous stage; in the present instance there is perfect fruit sent under the same number.)

359. SPHÆROTHECA PANNOSA, Lév. (*F. M. Bailey*, without a number.)

360. RHIZOMORPHA CORYNEPHORA, Kunze. One of the forms of the above variable species. (*F. M. Bailey*, no. 465.)

This beautiful mycelium clothes the tendrils of the vines with a silvery-white coat.

DESCRIPTION OF PLATE XXIX. (Plate XXX. is cancelled.)

Figs. 1–6. *Lentinus cochleatus*, Fr. 1–3, specimens as they appear when dried, nat. size; 4, the growing fungus as depicted in a water-colour sketch by Miss Campbell; 5, transverse section, apparently immediately below the pileus; 6, spores, highly magnified.

Fig. 7. *Polyporus* (§ *Placodermei*) *pectinatus*, Kl. Specimen of natural size.

Fig. 8. *Lachnocladium simulans*, Berk. & Broome, n. sp. *a* and *b*, specimen of nat. size as dried.

Fig. 9. *Cyphella Schneideri*, Berk. & Broome, n. sp. Specimen of nat. size, dried, growing on bark.

Figs. 10–14. *Tremella microscopica*, Berk. & Broome, n. sp. 10, a small piece of the dotted leaf with the fungus thereon, slightly enlarged; 11, a vertical section of the *Tremella*, highly magnified; 12, basidia; 13, spermatia; 14, filaments. Drawn from nature by Mr. Broome.

Figs. 15–17. *Sphæropsis Eucalypti*, Berk. & Broome, n. sp. 15, *Eucalyptus*-leaf dotted with the fungus, nat. size; 16, a fragment of the leaf containing one of the sclerotioid bodies, magnified, from a drawing by Mr. Broome; 17, the hyaline linear spores, still more highly magnified.

Figs. 18–21. *Tympanis toomanis*, Berk. & Broome, n. sp. 18, portion of cone of a species of *Banksia* with the fungus growing thereon, viz. the white spots between the protruding seeds, of nat. size; 19, a fungus, enlarged; 20, asci, magnified; 21, sporidia?, further magnified.

Figs. 22 & 23. *Hypoxylon Baileyi*, Berk. & Broome (*Nummularia Baileyi*, Cooke). 22, piece of wood with plant thereon, of nat. size; 23, spores, highly magnified.

Figs. 24–27. *Hypoxylon flavo-fuscum*, Berk. & Broome, n. sp. 24, dried piece of grass-root with fungus, of nat. size; 25, sketch by Mr. Broome of portion of the head, enlarged; 26, asci; 27, spores, greatly magnified.

Figs. 28–30. *Dothidea Fimbristylis*, Berk. & Broome. 28, fungus attached to the dried *Fimbristylis*, nat. size; 29, asci, and 30, spores, highly magnified: Mr. Broome's sketches.

Figs. 31–35. *Sphæria* (§ *Subtecta*) *Macrozamiæ*, Berk. and Broome, n. sp. 31, nut of *Macrozamia*, with dotted fungus on its surface, nat. size; 32, small portion of the fungus, enlarged; 33, asci, more highly magnified; 34, ascus containing spores; 35, separate spores, further magnified.

Figs. 36–39. *Sphæria* (§ *Subtecta*) *Sacchari*, Berk. & Broome, n. sp. 36, two pieces of sugar-cane leaf dotted with fungus, nat. size; 37, asci; 38, septate threads; 39, sporidia, drawn by Mr. Broome, all highly magnified.

Figs. 40–42. *Sphærella Litseæ*, Berk. & Broome, n. sp. 40, portion of a leaf of *Litsea*, with fungus-spots, nat. size; 41, asci; 42, sporidia, highly magnified: after Broome.

Figs. 43–45. *Sphærella Dammaræ*, Berk. & Broome, n. sp. 43, leaf of *Dammara robusta*, C. Moore, with patches of fungus, nat. size; 44, asci; 45, spores, highly magnified: Mr. Broome's sketch.

PLATE XXX.

The materials intended for two Plates (XXIX. & XXX.) have been included in one, viz. XXIX., so that Plate XXX. has been entirely dispensed with; Plate XXXI. in the paper following having been previously printed.

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ON A NEW SPECIES OF RHIPILIA (*R. Andersonii*) FROM MERGUI ARCHIPELAGO;

AND

ON TWO NEW SPECIES OF LENTINUS, ONE OF THEM GROWING ON A LARGE SCLEROTIUM.

BY

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September 1886.

XII. *On a new Species of* Rhipilia (R. Andersonii) *from Mergui Archipelago. By* GEORGE MURRAY, *F.L.S., Assistant, British Museum (Natural History), and Lecturer on Botany, St. George's Hospital Medical School.*

(Plate XXXI.)

Read March 4th, 1886.

THE *Rhipilia* which is the subject of this paper was collected by Dr. John Anderson in the Mergui Archipelago in February 1882, and presented to the British Museum in January of this year; it was found growing on mudflats at low water (spring tides) in King's Island Bay. The genus *Rhipilia* was established by Kützing ('Tabulæ Phycologicæ,' Bd. viii. 1858) for the reception of two species (*R. tomentosa*, Kütz., and *R. longicaulis*, Kütz.) collected by Sonder in the Antilles. To these the late Professor Dickie added a third species, *R. Rawsoni*, from Barbadoes (Linn. Soc. Journ., Bot. vol. xiv. p. 151), of which the type specimens are now in the British Museum. Professor Dickie had, about this time, intended to add another species from Mauritius (collected by Colonel Pike) under the name of *R. polydactyla*, and the plant is so labelled by him in the Kew Herbarium. On referring, however, to Dickie's own Herbarium in the British Museum, it was seen that "*R. polydactyla*, n. s.," had been cancelled by him and the alga placed under its true name, *Spongocladia vaucheriæformis*, Aresch., and so published in Linn. Soc. Journ., Bot. vol. xiv. p. 199.

To these three species I now propose to add a fourth, bearing the name of Dr. Anderson, who found it.

RHIPILIA ANDERSONII, n. sp.: sessilis, integro-flabelliformis, interdum paulisper lacerata; textura coacta, tomentosa; cœlomata regulariter dichotoma, inferne fulva, sursum fulvo-aurantiaca, irregulariter et longis intervallis constricta, apicibus obtusis subclavatis; rhizinæ inæqualiter torulosæ.

This species differs from *R. longicaulis* and *R. tomentosa* in the frond being completely sessile on the mass of rhizoids, and from *R. Rawsoni*, which has a much lobed sessile frond, in having an entire one. It agrees with *R. Rawsoni* in having obtuse subclavate apices to the frond-filaments, though in *R. Rawsoni* these are torulose throughout their length. *R. longicaulis* has hair-like points to its torulose filaments, and *R. tomentosa* has irregularly branching filaments with dilated apices. All the species have regularly dichotomous branches, except *R. tomentosa*, which Kützing describes as "irregulariter ramosissima, subdichotoma." Kützing founded the genus on two stipitate forms, while both Professor Dickie's *R. Rawsoni* and the present one are sessile.

With the exception of an immature specimen, which I was unable to examine critically, labelled *R. longicaulis*, from Australia, in the Kew Herbarium, there has, until now, been no record of the occurrence of a *Rhipilia* away from the West Indies. However, on seeing Dr. Anderson's plants I was led to re-examine some fragmentary specimens in the British-Museum Herbarium labelled "Cuming, Philippines," which had hitherto defied identification; they consisted of fronds only, plucked off from the rhizoids, which had been left immersed in the mud, and these were badly preserved. In the light thrown on them by Dr. Anderson's specimens (brought home in spirit in excellent condition) there was no difficulty in recognizing Cuming's plants to be none other than our *Rhipilia Andersonii*. It is well known that Cuming collected in other places than the Philippines, and, moreover, there is reason to believe that many of his plants supposed formerly to be Philippine are from other regions. There is no doubt that he collected in Malacca, and at all events the possibility is not excluded of this unnumbered alga having been collected by Cuming in the region from which Dr. Anderson has now brought us these excellent and complete specimens. To Cuming, anyhow, belongs the credit of having collected the first oriental *Rhipilia*, though it may be regretted that he collected it so badly.

As has been mentioned, the *Rhipilia* from Mergui was found inhabiting mudflats at low water of spring tides. The rhizoids penetrate the soil to a depth of three or four inches, and when drawn forth bring with them a cylindrical mass of small stones, broken shells, and other like débris matted together by the interwoven filaments. Above this mass of rhizoids sunk in the mud the sessile frond waves freely in the water. I carefully examined the filaments of the frond for organs of reproduction or propagation, but without success. The filaments are regularly dichotomous (Plate XXXI. figs. 3*a*–3*e*), usually constricted at the point of origin, and some of them at one or more places throughout their course. As preserved in spirit they are pale or pale yellow beneath, and become in most cases of a rich orange towards the apex, with, in many cases, yellow tips *. With these are mixed younger filaments of equal length, filled with granular colourless protoplasm up to the apex. Sometimes the colouring-matter is so distributed at the apex that an appearance is conveyed of a special cell occupying that portion, in shape like the zoosporangium of *Saprolegnia*; however, after employing the usual methods, no indication of such a cell could be discovered.

The rhizoid filaments are of unequal diameter; but, on the average, they resemble those of the frond in this respect. They are frequently and irregularly constricted—in a wide sense, torulose. They terminate sometimes in fine filaments, sometimes in blunt unequal apices; these unequal ends and frequent irregular constrictions may probably be due to the passage of the filaments through the stony soil, though it ought to be borne in mind that other species are regularly torulose even in the frond.

The rhizoids contain in great abundance—at some places in densely packed masses, at others in more scattered fashion—starch-granules of a somewhat peculiar kind. They are of fairly uniform size, and most of them are nearly kidney-shaped, while a careful

* Dr. Anderson mentions that in the fresh state the frond is of a bronze-green tint with the free margin of an orange hue, as shown in Plate XXXI.

examination of them did not enable me to detect any stratification; nor did the use of the polariscope help me in this respect. After treatment with iodine they show a pale violet colour. Granules of precisely similar size and form occur in the rhizoids of a specimen of *R. longicaulis* collected by Mr. Moseley at St. Thomas, which I examined among the 'Challenger' algæ in the British Museum. For what purpose so vast a store of reserve material is required by the plant can hardly even be guessed at in our present ignorance of the biology of these algæ. The mass of it is out of all proportion to the size of the frond, for example; and though *R. longicaulis* has a distinct rhizome-like branching, which might indicate the direction in which it is employed, nothing of the kind is to be seen in *R. Andersonii*. An examination of these algæ in their native seas can alone furnish us with an explanation.

DESCRIPTION OF PLATE XXXI.

Figs. 1, 2. *Rhipilia Andersonii*, G. Murr. Nat. size.
Figs. 3 *a*, 3 *b*, 3 *c*, 3 *d*, 3 *e*. Frond-filaments. × 112½.
Figs. 4 *a*, 4 *b*, 4 *c*. Rhizoid filaments containing starch. × 112½.
Fig. 4 *d*. The same. × 450.
Fig. 5. Starch-granules. × 900.

G. Murray

Berjeau lith.

RHIPILIA ANDERSONII, n. sp.

Hanhart imp.

XIII.—*On two new Species of* Lentinus, *one of them growing on a large Sclerotium.* *By* GEORGE MURRAY, F.L.S., *Assistant, British Museum (Natural History), and Lecturer on Botany, St. George's Hospital Medical School.*

(Plate XXXII.)

Read March 4th, 1886.

THERE is a description accompanied by an illustration in Rumphius's 'Herbarium Amboinense' (sixth part, lib. xi. cap. xvii. p. 120, tab. 57) of a large sclerotioid body which he terms *Tuber regium*: "pluvia calida et sole splendente vel tonitruoso cœlo ex ipso Boletus excrescit aliquando simplex, aliquando duplex, aliquando plures simul, quorum tamen semper unus maximus est." The figure and description given by Rumphius of the so-called "Boletus" enabled Fries to determine it (Syst. Mycol. vol. i. p. 174) as *Agaricus Tuber-regium*, and subsequently to place it in his genus *Lentinus* in the 'Epicrisis' (p. 392). The *Tuber regium* itself Fries took to be a *Pachyma*, which he terms *Pachyma Tuber-regium* (Syst. Mycol. vol. ii. p. 243). Rumphius gives an interesting account of the appearance of both fungi and of their reputed properties. Speaking of the pileus he says that when young it is "coctioni aptus." At another place he goes further than this somewhat cautious phrase, and states that besides being fit for cooking it is possible to eat it, "sed cibus hic durus est." The "radix," however, was good as a remedy for diarrhœa, fevers, and "dolentes fauces," &c. Fries tells us he had not seen specimens, and indeed no mycologist appears to have done so from the time of Rumphius till now. Considerable interest therefore is attached to a specimen of a *Lentinus* growing on what appeared to be a *Pachyma* collected by the Rev. Mr. Whitmee in Samoa, and presented by him to the Department of Botany, British Museum. It was not only possibly the long-lost *Lentinus Tuber-regium*, but appearances suggested the origin of the *Lentinus* from the sclerotium, and hence an explanation of the obscure nature of *Pachyma*. Both of these seductive suggestions, however, were broken down by investigation. First of all, though strongly resembling *L. Tuber-regium*, Fr., Mr. Whitmee's specimen differs from it in the pileus and stalk being densely covered with fine short hairs instead of being glabrous, in the colour, &c.; and since it does not agree with the description of any other species of *Lentinus* known to me, I propose to describe it as follows:—

LENTINUS SCLEROTICOLA, n. sp.; pileo profunde infundibuliformi, coriaceo, cervino, scabriusculo; stipite ochraceo, scabriusculo, solido, longo, versus basin attenuato; lamellis decurrentibus cervino-brunneis.

Rumphius describes the pileus as becoming laciniated with age; and though Mr. Whitmee's specimen is cracked, &c., at the edge of the pileus, the fractures are manifestly the result of injury during transport, and not due to any process of development.

I have therefore ventured to restore the margin of the pileus in the accompanying figure of it.

I was next disappointed in failing to identify the sclerotium with *Pachyma*. The tissue is, as the figure shows, that of a true sclerotium, a plexus of hyphæ densely interwoven, and, while varying in the diameter of the filaments, yet fairly uniform. *Pachyma* on the other hand (see Trans. Linn. Soc. vol. xxiii. tab. ix. figs. 7 and 8) appears to consist of masses of pectine traversed by fungal hyphæ, and to deserve the name of a sclerotioid body rather than of a sclerotium. The Rev. Mr. Berkeley, in referring (Introduction to Cryptogamic Botany, p. 288) to the Tuckahoe or Indian Bread of North America (*Pachyma Cocos*, Fr.), says that "it is not a true fungus, but a state of certain unknown roots in which their structure is converted into pectic acid." The Tuckahoe or Indian Bread has been recently reported on by Prof. J. Howard Gore at p. 687 of the Annual Report of the Board of Regents of the Smithsonian Institution for the year 1881 (Washington, 1883). Prof. Gore made "a critical inspection of its structure, and an examination of many specimens at different stages of development;" and as a result of this he found among other things that "at some season of the year spores are given off and transmitted by insects, water, or other natural means, and are attached to the roots of other trees suitable for its production." Undoubtedly the investigation of so obscure a question as the nature of *Pachyma* requires a suitable state not only in the development of the material, but in that of the observer as well; and judging by the evidence of Prof. Gore's report, I venture to think he has not brought us much nearer an explanation of this matter. Mr. Berkeley in a paper on *Pachyma* from China (Linn. Soc. Journ. of Proc. vol. iii. Bot. p. 107) says, "No fungus has ever been found on the American or Chinese tubers, and, unfortunately, *Pachyma Tuber-regium*, which gives rise to a species of *Lentinus*, as figured by Rumphius, is quite unknown. It is probably, however, of the same nature with the Pietra funghaja or fungus-stone of Italy (a mere mass of earth and mycelium)." Whether Fries was right in interpreting Rumphius's *Tuber regium* to be a *Pachyma* or Mr. Berkeley in thinking it resembled the Pietra funghaja, there is no means of determining absolutely from Rumphius's description or figure, though "a mere mass of earth and mycelium" would hardly be likely to possess the properties as a food &c. ascribed by Rumphius to his *Tuber regium*. In this absence of evidence it would be wholly unwarrantable to set up a claim for the true sclerotium collected by Mr. Whitmee to be the *Tuber regium* of Rumphius, though a description of it will show a striking correspondence. Its tissues are traversed in all directions by rhizoids of *Lentinus* varying in diameter, and not only by rhizoids of the *Lentinus* actually growing upon it, but by others, one of which I have carefully traced to one of the three or four external pits where doubtless previous individuals had grown forth (see fig. 1, *a*). The explanation inevitably suggested by the course of these strings of hyphæ is that originally a *Lentinus* spore or spores had germinated upon the surface of the sclerotium, had pushed out rhizoids into the mass, and that the mycelium thus attaining the interior had become perennial there, producing from time to time crops of *Lentinus* from the surface under favourable circumstances, such as those described by Rumphius for his *Tuber regium*. Though it is impossible to reach certainty in a matter of this kind, yet it may be urged from this evidence that Fries was probably nearer the truth than Mr. Berkeley, and that there is at all events a strong presumption in favour of regarding Rumphius's *Tuber regium* as a sclerotium like to, if not identical with, the one I have described here. Though the *Lentinus* is of a different species (at least I should not be justified in regarding it as the same from the description) this brings no direct evidence against the opinion.

Dr. H. B. Guppy, who spent some time in the Solomon Islands, having seen this Samoan specimen, has kindly furnished me with a note on the occurrence of similar bodies in the Solomon Islands. He says :—

"My attention was first directed to these singular bodies in 1882 by the traders living on the island of Santa Anna at the eastern end of the group, and I at once set about learning more about them. In external appearance they somewhat resemble a Yam, and are usually about two pounds in weight, and others attain even a greater size. They lie *unattached on the soil*, scattered about among fragments of coral-limestone, and did not come under my notice in islands other than of calcareous formation. At first I thought they might have dropped from the branches of trees, but the position of many of them negatived this idea. In the opinion of the natives of Santa Anna, who have named them in their own tongue 'devil's testicles,' they are poisonous. Inside they are white, sometimes with a waxy look, and the larger ones when cut across look like compressed flour. Mr. Stephens, a trader at Ugi, an adjacent island, on learning that I was curious about them, procured some, and subsequently informed me that from one of them sprung *mushroom-like growths* which fell away in a few weeks. I had no opportunity of seeing these mushroom-like growths myself, nor had they come under the notice of previous residents in the group. These tuberous masses, however, were new to them as well as to me, and might easily escape observation on account of their dark colour matching that of the soil as well as the hue of the weathered surface of the coral-limestone fragments. As far as I can judge now, they appear identical with the specimen from Samoa in your collection."

Dr. Guppy recommended one of the traders to cook one of these bodies, "but only a tasteless fibrous substance resulted." He has kindly offered to write to one of the traders to make observations and send home specimens, and the result cannot fail to be of interest. It is particularly to be hoped that the origin of the large sclerotium may be discovered.

Since the above was written, Mr. Broome has with very great kindness shown me a specimen of *Lentinus cyathus*, Berk. & Broome, growing on a large sclerotium, from Brisbane. The sclerotium is of almost identical appearance with mine, and I had already noted the fact that my *Lentinus scleroticola* stands very near to *L. cyathus*, Berk. & Broome. An examination of Mr. Broome's excellent specimen confirms me in this opinion, and in fact I would place the species side by side. *L. scleroticola* differs from *L. cyathus* in the gills being much finer and far more numerous, in the pileus being thinner and more deeply infundibuliform, and in the tapering downwards of the stem &c. The rhizoids of *L. cyathus* penetrate the sclerotium in precisely the same fashion, and I notice besides on the outside of its sclerotium several pits where former plants of

Lentinus grew forth, as in the case of *L. scleroticola.* We have here then just such another case of a *Lentinus,* the mycelium of which is a perennial inhabitant of a large sclerotium.

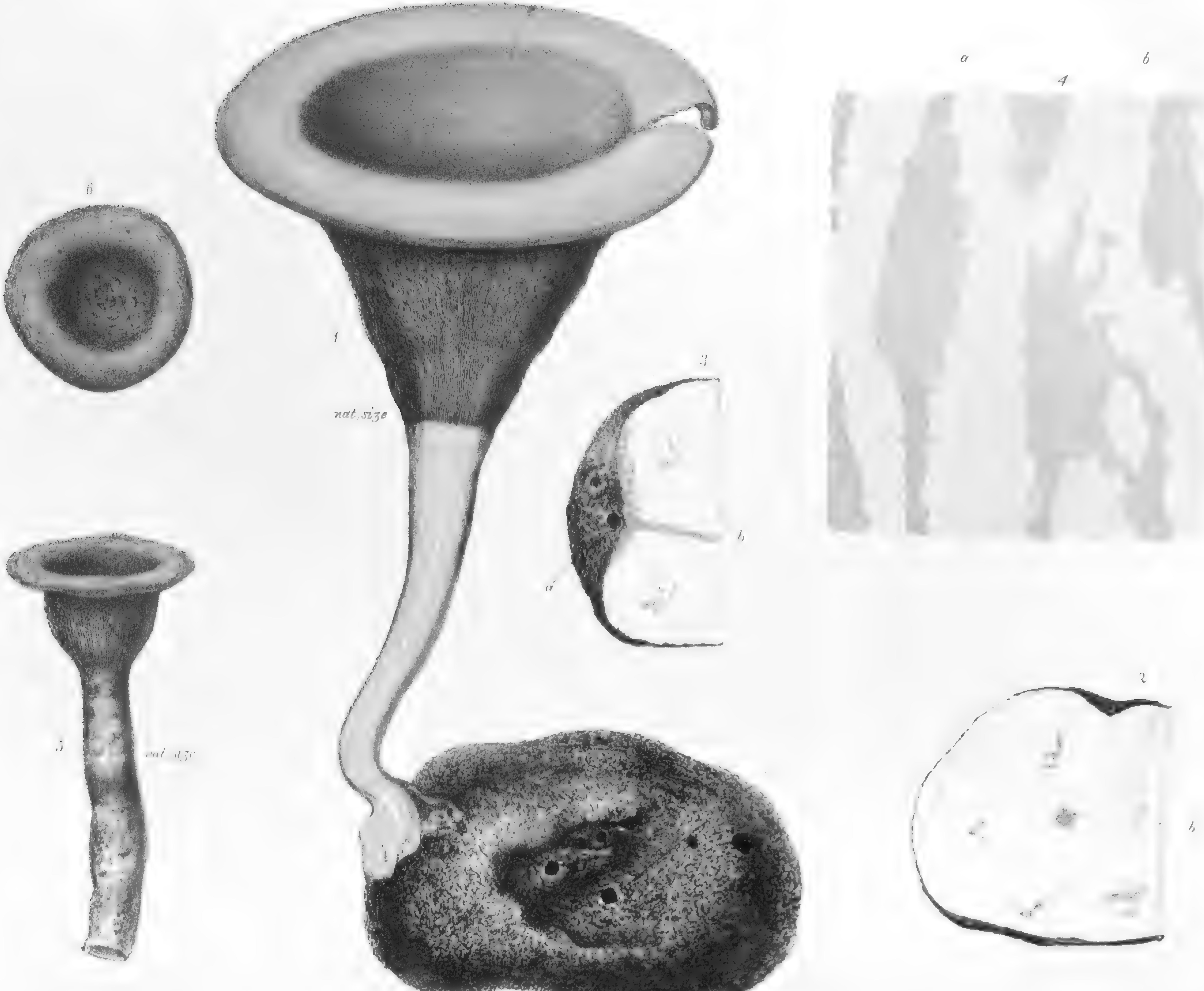
The other *Lentinus* referred to in the heading of this paper was collected by the Rev. W. E. Taylor in the Rabai Hills, Mombaz, East Africa, during the autumn of last year. He has already sent home to the British Museum a very interesting and extensive series of plants from that region, and he is now, in spite of difficulty and danger, engaged in collecting both the flora and fauna of this region. I have much pleasure in associating his name with this new *Lentinus.*

LENTINUS TAYLORII, n. sp.; pileo crateriformi, coriaceo, umbrino squamis subconcentricis ad basin ornato, margine revoluto, integro; stipite longo, solido, fulvo, fusco-maculato, versus basin squamuloso, cavo; lamellis decurrentibus, fuscis.

The lower extremity of the stem was broken off an inch or so below the surface of the ground.

DESCRIPTION OF PLATE XXXII.

Fig. 1. *Lentinus scleroticola,* G. Murr. (nat. size), on sclerotium.
Fig. 2. Section through sclerotium showing *Lentinus* rhizoids. Nat. size.
Fig. 3. Another section through sclerotium following direction of rhizoids terminating externally at *a*, fig. 1, and seen in section fig. 2 at *b*. Nat. size.
Fig. 4. Section of portion of sclerotium: *a*, Lentinus rhizoids; *b*, sclerotium tissue. $\times 450$.
Fig. 5. *Lentinus Taylorii,* G. Murr. Nat. size.
Fig. 6. View of pileus from above. Nat. size.


1
nat. size
2
3
4
5
6
a
b

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	Part V.	1883	0	3	0	0	2	3
	Part VI.	1884	0	13	6	0	10	0
	Part VII.	1884	0	9	6	0	7	0
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2nd Ser. BOTANY.] [VOL. II. PART 12.

THE

TRANSACTIONS

OF

THE LINNEAN SOCIETY OF LONDON.

ON NEW SPECIES OF BALANOPHORA AND THONNINGIA,

WITH A NOTE ON

Brugmansia Lowi, Beccari.

BY

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XIV. *On new Species of* Balanophora *and* Thonningia, *with a note on* Brugmansia Lowi, *Becc.* *By* William Fawcett, *B.Sc., F.L.S., Assistant in the Botanical Department, British Museum.*

(Plates XXXIII.–XXXVI.)

Read 18th March, 1886.

I. On Balanophoræ.

Balanophora Hildebrandtii, Reichb. fil.—During the 2nd voyage of Capt. Cook, Forster discovered in Tanna, one of the New Hebrides, a singular plant, which he called *Balanophora fungosa.* Dr. Anderson, the surgeon to the Expedition, made drawings of several rare plants which were met with, and among them there is one of *B. fungosa,* dated 9 Aug., 1774. The genus was established by Forster in his 'Characteres Generum Plantarum,' published in 1776. Anderson's specimen and drawing are preserved in the British Museum.

During the first voyage, however, Banks and Solander had discovered a species of *Balanophora* in Tahiti, in 1769, which was figured by S. Parkinson at the time. It was described by Solander in his MSS. as *Acroblastum pallens,* and placed by Seemann, in his 'Flora Vitiensis,' under *B. fungosa,* Forst., where Solander's description is given in full. I have examined both specimen and drawing of this plant in the Museum, and have identified it with a *Balanophora* discovered in Comoro Isles by Hildebrandt in 1875, and described by Reichenbach, fil., in the 'Journal of Botany,' 1876, as *B. Hildebrandtii.* Hildebrandt's specimen only differs in being much larger, but we have lately received other specimens of about the same size as the Tahiti plant, collected also in the Comoro Isles, by Humblot.

It seems strange that the same species should only have been found in such widely separated spots as Tahiti and the Comoro Isles, but when we consider that *Cynomorium coccineum* occurs in isolated spots from the Canary Islands to the Levant, we may hope that this *Balanophora* will be found in places intermediate between the habitats at present known. The geographical distribution need not be considered impossible; we may adduce the case of the Orchid, *Cirrhopetalum Thouarsii,* Lindl., which is found in Madagascar and Tahiti, and also in the intermediate stations, Mauritius, Java, and Manilla.

The anthers have hexagonal thecæ, and this species is the only one which is similar in this respect to the Indian *B. polyandra,* Griff., from which it is readily distinguished by the capitula being bi-sexual.

Reichenbach has given a very short description, and I therefore subjoin one, giving more details.

B. Hildebrandtii, Reichb. f.; rhizomate tuberoso pustulato, squamis pedunculi imbricatis, capitulis bisexualibus, florum masculorum bracteis liberis nec in favum combinatis, antherarum thecis numerosis (12–15) hexagonis in capitulum coalitis, singulatim poro dehiscentibus; floribus femineis in receptaculo inter spadicellos obovato-truncatos dispositis.—*B. fungosa*, Seemann (non Forster), Flora Vitiensis, p. 99. *Acroblastum pallens*, Solander, MSS., "Primitiæ Floræ Insularum Oceani Pacifici," pp. 310, 311; S. Parkinson's Drawings of Tahiti Plants, t. 91 (ined.); "'Ea-owa' Tahitensibus," Solander. Spec. in herb. Mus. Brit.

Hab. Tahiti (*Banks & Solander*): Comoro Is. (*Hildebrandt*, *Humblot*).

Rhizoma magnitudine nucis juglandis, "albidum" (Sol.), tuberosum, minute papillosum, stellato-pustulatum. Volva brevis irregulariter lobata. Spadices, pedunculo incluso, 9–14½ cm. longi; squamæ haud numerosæ, oblongo-ovatæ, 1½–3 cm. longæ, apicibus capitula haud attingentibus. Capitulum bisexuale, floribus masculis infra capitulum ut in *B. fungosa*, ovato-cylindricum. Bracteæ florum masculorum semilunatæ liberæ nec in favum combinatæ. Flores ♂ sessiles, lobis perianthii 4, lateralibus lanceolatis, medianis 2–3-plo latioribus. Antherarum capitulum in receptaculo ut in *B. polyandra* insertum, thecis numerosis (12–15) hexagonis.

B. Zollingerii (nov. sp.).—This is a plant found in the island of Salayer by Zollinger, and distributed by him under the number 3323. No doubt, as often happens, more than one species may have been distributed under this number, for Eichler determines the plant to be *B. abbreviata*. The Brit. Mus. specimen, however, differs from it (1) in the ♂ flowers having anthers with hippocrepiform thecæ, and (2) in the capitula being small, sessile, and globose. From *B. fungosa* it differs in habit, the ♀ flowers, the sessile capitula, and the pustulate rhizome.

B. Zollingerii; rhizomate pustulato, capitulo bisexuali sessili squamis fere occluso, antherarum thecis hippocrepiformibus; floribus ♀ in receptaculo dispositis.

Hab. Ins. Salayer (*Zollinger*, 3323, partim.). Herb. Mus. Brit.

Rhizoma lobatum, nucis Avellanæ magnitudine, minute verrucosum, pustulatum. Volva irregulariter lobata. Capitulum parvum, sessile, globosum, squamis suborbicularibus 4–6 mm. longis imbricatis fere occlusum. Flores ♂ ad basim capituli, perigonii phyllis 4–5, antherarum thecis in capitulum subglobosum coalitis, hippocrepiformibus, rimis 2 hippocrepicis parallelis dehiscentibus. Flores ♀ in receptaculo nec ad spadicellos elongato-obovatos dispositi.

B. decurrens (nov. sp.).—This species is founded on a plant sent by Don J. G. Azaola, from Luzon, in 1846. It might at first sight be taken for a variety of *B. dioica*, R. Br., but differs in the ♀ flowers being on the receptacle only, in the capitula of anthers being oblong, and the scales of the peduncle decurrent. The very long floral peduncle reminds one of *B. elongata*, but the hippocrepiform shape of the anthers at once distinguishes it.

B. decurrens; rhizomate lobato, minute verruculoso, epustulato, squamis imbricatis decurrentibus, capitulis dioicis, antherarum thecis 4 hippocrepiformibus, rimis hippocrepiformibus dehiscentibus; floribus femineis in receptaculo dispositis.

Hab. Luzon, Philippine Is. (*Don J. G. Azaola*, 1846). Herb. Mus. Brit.

Rhizoma lobatum, ovi gallinacei-pugni magnitudine, minute verruculosum, epustulatum. Volva irregulariter repando-dentata. Stipites florales 6–18 cm. longi, pedunculo cylindrico elongato, squamis imbricatis, 1–3 cm. longis, a basi ad apicem gradatim accrescentibus lato-oblongis longe decurrentibus totum pedunculum obtegentibus. Capitula ♂ obovata, 3–4 cm. longa. Bracteæ margine ad apicem truncato crasso in favi speciem basi connatæ. Flores ♂ 7–8 mm. longi; perigonium 4–5-phyllum phyllis ovatis subæqualibus intus lævibus. Antherarum capitulum ovoideo-oblongum, 3 mm. longum, thecis 4 hippocrepiformibus, rimis hippocrepiformibus dehiscentibus. Capitula ♀ oblonga-ovoidea, floribus in receptaculo nec ad spadicellos sessiles oblongo-obovatos dispositis.

B. TYPHINA, Wall. no. 7248.—Mr. J. J. Bennett in a note to Griffith's paper "On the Indian species of *Balanophora*" (Trans. Linn. Soc. xx. p. 95) says that "*B. typhina*, Wall. List. no. 7248, appears to be identical with *B. picta*, Griff." a species which was afterwards placed under *B. dioica*, R. Br. There are several specimens on the sheet marked 7248 in the Wallichian Herbarium of the Linnean Society, but none of them is *B. dioica*. Those marked A and B are *B. polyandra*, Griff., and no. 3 appears to be *B. indica*, Wall.

B. GIGANTEA, Wall.—In the same note, Mr. Bennett identifies, though doubfully, *B. gigantea*, Wall., with *B. globosa*, Jungh. There are very fine specimens of *B. gigantea*, Wall., in the British Museum Herbarium sent from Wallich to Robert Brown, which show that it differs from Junghuhn's species in the ♀ flowers being both on the spadicels and receptacle, and in the form of the spadicels. The form of the thecæ of the anthers is like that in *B. indica*, Wall., to which species it has a great resemblance, and may be a variety of it; it differs in the rhizome, which has no pustules, and is tesselated rather than warty. The following is a full description.

B. gigantea, Wall. List. n. 7249; rhizomate composito-lobato hexagono-tesselato haud pustulato, squamis pedunculi laxis imbricatis, capitulis dioicis, antherarum thecis 4–6 hippocrepiformibus, rimis hippocrepiformibus dehiscentibus, floribus femineis ad spadicellos et in receptaculo dispositis.

Hab. Taong Dong, Burmah (*Dr. Wallich*). Herb. Mus. Brit.

Rhizoma ut in *B. abbreviata*, sed tesselatum haud pustulatum. Spadices masculi, pedunculo incluso, 6–9 cm. longi; pedunculus 2–3 cm. longus; squamæ laxæ late oblongo-ovatæ 1–5 cm. longæ, superioribus maximis capitulum involucrantibus. Capitulum ♂ ovatum vel cylindricum, 3–6 cm. longum, bracteis liberis semilunatis 5–7 mm. longis, floribus pedicellatis patentibus, $1\frac{1}{2}$ cm. longis, lobis perianthii 4–5 omnibus oblongis. Antherarum capitulum compressum, thecis 4–6 hippocrepiformibus, rimis hippocrepiformibus dehiscentibus. Spadices feminei, pedunculo incluso, 7–13 cm. longi; pedunculus 4–10 cm. longus; squamæ numerosæ late ovatæ laxæ patentes. Capitulum ♀ subglobosum 2–3 cm. longum. Flores ♀ longe pedicellati in receptaculo et ad stipites spadicellorum oblongo-truncatorum dispositi.

B. RAMOSA (nov. sp.).—This species comes near *B. globosa*, Jungh., but differs in the branching rhizome, and the ♀ flowers being on both the receptacle and the stalked spadicels. It was found in S.E. Java by Mr. H. O. Forbes, and is the same as a specimen sent from Java by De Vriese.

B. ramosa; rhizomate ramoso tesselato haud pustulato, squamis pedunculi numerosis confertis imbricatis, capitulis dioicis, femineis sub-globosis, floribus femineis ad spadicellos et in receptaculo dispositis.

Hab. Java (*De Vriese*); S.E. Java (*H. O. Forbes*, no. 1140, A.). Herb. Mus. Brit.

Rhizoma pomi magnitudine, e centro communi ramosum, totum tesselatum. Spadices feminei, incluso pedunculo, 3–7 cm. longi, pedunculus $\frac{1}{2}$–$4\frac{1}{2}$ cm. longus, squamis confertis appressis late oblongo-ovatis, $\frac{1}{2}$–$2\frac{1}{2}$ cm. longis. Capitulum femineum subglobosum vel oblongum, 2–3 cm. longum. Flores ♀ in receptaculo et ad stipites spadicellorum ovato-truncatorum dispositi, sessiles vel breviter pedicellati. Flores ♂ adhuc incogniti sunt.

B. MULTIBRACHIATA (nov. sp.).—This species differs from *B. globosa*, Jungh., and *B. elongata*, Blume, in the rhizome, the thecæ of the anthers, and the spadicels. It was brought from Sumatra by Mr. H. O. Forbes, and appears to be the same as one of the plants distributed by Zollinger under the no. 2948.

B. multibrachiata; rhizomate ramoso verruculoso pustulato, squamis confertis imbricatis, capitulis dioicis, antherarum thecis numerosissimis, longitudinalibus rimis longitrorsis dehiscentibus; floribus femineis in receptaculo dispositis.

Hab. Sumatra (*H. O. Forbes*, no. 2545, B; *Zollinger*, 2948). Herb. Mus. Brit.

Rhizoma pomi majoris circuitu, e centro communi ramosum, ramis dichotomis lobatis, verruculosum, pustulatum. Volva brevis 4–6-lobata. Spadices solum juveniles cogniti brevissimi, 3 cm. longi; pedunculus subobsoletus, squamis confertis late ovatis capitulum juvenile velantibus. Capitulum ♂ cylindricum $1\frac{1}{2}$–2 cm. longum, bracteis liberis, floribus juvenilibus in alveolos immersis, lobis perianthii 4 inapertis, lateralibus lanceolatis, medianis 3–4-plo latioribus. Antherarum capitulum valde compressum, thecis 23–25, coalitis, linearibus, longitudinalibus, nunc confluentibus. Capitulum ♀ cylindricum 1–$1\frac{1}{2}$ cm. longum. Flores in receptaculo inter spadicellos sessiles oblongos dispositi.

B. FORBESII (nov. sp.).—This species comes near *B. Lowii*, Hook. f., but differs in the branching rhizome, which is without pustules.

B. Forbesii; rhizomate composito-lobato, minute verruculoso, haud pustulato, squamis confertis imbricatis, capitulis dioicis, antherarum thecis numerosis, longitudinalibus rimis longitrorsis dehiscentibus; floribus femineis in receptaculo dispositis.

Hab. S.E. Java (*H. O. Forbes*, no. 1140, A). Herb. Mus. Brit.

Rhizoma pomi magnitudine, e lobis numerosis compositum, lobis obovoideis, totum minute verruculosum, haud pustulatum. Volva irregulariter lobata. Spadices masculi, pedunculo incluso, $2\frac{1}{2}$–7 cm. longi; pedunculus 0–3 cm. longus, squamis confertis ovatis oblongisve 1–2 cm. longis, capitulum subvelantibus. Capitulum ♂ cylindricum $2\frac{1}{2}$–4 cm. longum, bracteis liberis semilunatis, 2 mm. longis, floribus pedicellatis patentibus, 7 mm. longis, lobis perianthii 4, omnibus oblongis obtusis, anthesi reflexis. Antherarum capitulum valde compressum, pedicellatum obovoideum, thecis numerosis (9–10), linearibus, longitudinalibus. Spadices feminei, pedunculo incluso, $2\frac{1}{2}$–8 cm. longi; pedunculus 1–6 cm. longus, squamis confertis ovatis oblongisve 1–2 cm. longis, his ad apicem majoribus et latioribus capitulum subvelantibus. Capitulum ♀ cylindricum, $1\frac{1}{2}$–2 cm. longum. Flores in receptaculo inter spadicellos sessiles oblongos dispositi.

The following Key shows the relation of the new species of *Balanophora* to those already described :—

I. Anthers equal in number to leaves of perianth, dehiscing by a transverse chink.

1. *B. involucrata,* Hook. f.
   Scales verticillate in middle of peduncle.

2. *B. Harlandi,* Hook. f.
   Scales free, crowded at base.

II. Anthers equal in number to perianth-leaves, hippocrepiform, dehiscing by two hippocrepiform chinks.

(*a*) Capitula unisexual.

3. *B. dioica,* R. Br.
   Capitula cylindrical; rhizome pustulate; ♂ perianth-lobes ovate, patent; ♀ fls. on spadic. and recept.

4. *B. decurrens* (n. sp.).
   Capitula cylindrical; rhizome without pustules; ♂ perianth-lobes ovate, patent; ♀ fls. on recept.; scales decurrent.

5. *B. indica,* Wall.
   Capitula obovoid; rhizome pustulate; ♂ perianth-lobes long linear, reflexed; ♀ fls. on spadic. and recept.

6. *B. gigantea,* Wall.
   Capitula obovoid; rhizome without pustules, tesselated; ♀ fls. on spadic. and recept.

(*b*) Capitula bisexual.

7. *B. fungosa,* Forst.
   Capitula pedunculate; rhizome without pustules.

8. *B. Zollingerii* (n. sp.).
   Capitula sessile; rhizome pustulate.

III. Thecæ of anthers more numerous (8–25) than the perianth-leaves, linear longitudinal.

(*a*) Rhizome tesselated, without pustules.

9. *B. globosa,* Jungh.
   ♀ fls. on recept., not on the subsessile spadic.; rhizome lobed.

10. *B. ramosa* (n. sp.).
   ♀ fls. on recept., and on the stalked spadic.; rhizome branching.

(*b*) Rhizome tesselated, with few pustules.

11. *B. reflexa*, Becc.
    ♀ fls. on recept., not on the subsessile spadic.; rhizome simple.

(*c*) Rhizome warty, with pustules; ♀ fls. on recept. only.

12. *B. elongata*, Blume.
    Capitula 1-sexual; thecæ 8–12; rhizome branching irregularly.
13. *B. abbreviata*, Blume.
    Capitula 2-sexual; thecæ 8–12; rhizome with small roundish lobes.
14. *B. multibrachiata* (n. sp.).
    Capitula 1-sexual; thecæ 23–25; rhizome branching, with dichotomous lobes.

(*d*) Rhizome minutely warty.

15. *B. Lowii*, Hook. f.
    Rhizome simple, pustulate.
16. *B. Forbesii* (n. sp.).
    Rhizome branching, without pustules.

IV. Thecæ of anthers hexagonal.

17. *B. polyandra*, Griff.
    Capitula 1-sexual; ♀ fls. on recept. and spadic.
18. *B. Hildebrandtii*, Reichb. fil.
    Capitula 2-sexual; ♀ fls. on recept. only.

II. On Thonningia malagasica.

In 1884 the Herbarium of the British Museum received specimens, preserved in spirit, of a Balanophoraceous plant sent from Madagascar by the Rev. W. Deans Cowan. These specimens, consisting of female capitula in flower, appeared to be a new species of *Thonningia*. The MSS. in which I described it were submitted to Sir J. D. Hooker, who had at the time just completed a paper on a male plant and fruiting capitula sent by Messrs. Humblot and Parker respectively from Madagascar. Suspecting that our plants were the same, he at once, with rare generosity, offered me his MSS. and drawings to add to my paper, and I am thus enabled to lay before the Society a full description of this interesting plant. Passages taken direct from Sir J. D. Hooker's MSS. I have placed between inverted commas.

"The discovery of a Balanophoraceous plant in Madagascar extends our knowledge of the geographical range of that curious family, and adds something to that of its morphology, and hence of the affinities of its genera. Hitherto only one Tropical-African species had been known, the monotypic *Thonningia* of Vahl, a native of Guinea, the original specimens of which, gathered in 1804, and preserved in the Royal Herbarium of Copenhagen, were sent to me for examination, and are figured in the Society's

Transactions *. The other African genera of Balanophoreæ are extra-tropical, consisting of *Cynomorium*, Micheli, in the north of the continent, and, in the south, *Sarcophyte*, Sparrm., and *Mystropetalon*, Harv. † These all belong to different tribes from *Thonningia*, which, as I have shown, is closely related to the American genus *Langsdorffia*."

The two species of *Thonningia* may readily be distinguished, for in *T. sanguinea*, Vahl, the peduncle is long, the scales acuminate, and the male perianth consists of a few scales placed at different heights on the pedicel; whereas in *T. malagasica* the peduncle is very short, the scales obtuse, and the male flower has a regular perianth. The following is a fuller description:—

T. MALAGASICA; "*rhizomate* elongato, flexuoso, cylindraceo, rigido, $\frac{1}{4}$–$\frac{1}{6}$ poll. diam.," volvis irregulariter lobatis, lobis 1–5 mm. longis; *capitulis* brevissime pedunculatis, "sparsis v. confertis, 1–1$\frac{1}{2}$ poll. diametro, squamis 60–80, obtusis, exterioribus v. inferioribus brevibus rotundatis, intimis $\frac{1}{2}$–$\frac{2}{3}$ poll. longis obovato-oblongis, scarioso-coriaceis apice laceris: *floribus masculis* $\frac{1}{2}$–$\frac{1}{3}$ poll. longis, erectis confertis, squamis obtectis, perianthis regulari, lobis 3 ovato-oblongis valvatis demum reflexis; antheris 3 (?), elongatis, confluentibus, filamentis in columnam connatis; *floribus femineis* stratum tenuissimum vix $\frac{1}{20}$ poll. crassum efformantibus," ovario cum vicinis coalito, margine ovarii tubuloso, 2$\frac{1}{2}$–3 mm. longo, obscure 3–4-dentato.

Hab. In sylvis Madagascariæ (*Humblot*, fl. ♂; *Deans Cowan*, fl. ♀ anth.; *Parker*, fl. ♀ fruct.).

The following is a detailed description of the anatomy of *T. malagasica*, in the preparation of which I owe very much to the exceedingly elaborate monograph of the Brazilian Balanophoreæ by Dr. A. W. Eichler ‡, and also, of course, to Sir J. D. Hooker's monograph *;—

The parts of the rhizome which we possess are cylindrical; the point of insertion on the host is not known; but the rhizome probably becomes tuberous there, as in *Langsdorffia* and *Helosis*.

The rhizome does not branch, but gives off flowering stems laterally. The epidermis is normally clothed with hairs, but frequently both epidermis and hairs are rubbed off, except immediately round the base of the flowering stem, where they are under the shelter of the capitulum.

The anatomical structure of the rhizome shows more points of resemblance with *Helosis* than with *Langsdorffia*. The greater portion of the tissue is parenchyma, through which several fibro-vascular bundles run longitudinally. There are four large bundles arranged in a circle near the centre, with the xylem inwards and phloëm outwards. Outside these, there is an irregular ring of several small bundles, which are remarkable for having the position of the xylem and phloëm reversed, that is, the phloëm faces inwards and the xylem outwards. Schimper, in his paper on "Die Vegetationsorgane von *Prosopanche*

* Trans. Linn. Soc. xxii. pp. 29 & 42, tab. 3.

† To which is now added *Balanophora* (see above, *Hildebrandtii*).

‡ Mart. Fl. Bras. fasc. 47, Balanophoreæ.

Burmeisteri" *, has shown that in its 4- or 5-sided rhizome there are four or five central bundles with normal orientation, and that near each angle in a transverse section there are several small bundles arranged on each side of an imaginary line joining the angle with the centre, in such a way that the bundles are placed sideways as regards the centre, with the xylem facing the imaginary line. But an opposite orientation, even more pronounced than in *Thonningia*, because repeated, occurs in the rhizome of *Nelumbium speciosum*, in which there are several concentric circles of bundles, the first and second of which nearest the centre are normal; the third is opposite, the fourth is normal, and the fifth is again opposite. Another example occurs in the cortical bundles of *Calycanthus occidentalis*.

The parenchyma of the rhizome is composed of cells which are twice or thrice longer than wide. Towards the periphery the cells become smaller, and are of the same diameter longitudinally as transversely. The epidermis is composed of irregular projecting cells, as in *Langsdorffia*. The hairs are a millimetre or more in length, composed of two cells, the basal one short and somewhat bulbous, the other long and slender. The cell-wall of the hairs is covered with very minute granular warts.

Several of the cells have their walls so much thickened that the central cavity has the appearance of a long pore from which very numerous branching pores pass off to the periphery. These sclerenchymatous cells ("stone-cells," as the Germans call them) are longer and somewhat broader than the ordinary cells; they occur in masses, running in longitudinal strands parallel with the fibro-vascular bundles. In *Langsdorffia* the part of the cell-wall which is in contact with the soft-walled parenchymatous cells remains unchanged; this is not so evident in *Thonningia*, since the cavity of the cell is extremely narrow, but it also occurs, and then the pores appear almost as if they originated on the cell-wall.

The axis of the rhizome is occupied by one of these sclerenchymatous strands of an elliptical outline in transverse section, and of so great a diameter that it is easily recognized by the naked eye. The cambium-layer of the four internal fibro-vascular bundles is fairly parallel with the long axis of the elliptical outline, which is vertical, the shorter axis being horizontal. Sometimes the cells in the centre of this axial strand have walls which are only half the thickness of those that occur elsewhere; sometimes the upper and lower parts of the strand are entirely separated by a band of the ordinary parenchymatous cells. The outer cells are occasionally compressed in a radial direction. It is interesting to trace the resemblance with *Helosis*, which has a greater differentiation of this axial strand, so much so that Eichler † speaks of the medulla and the rays. It is in this respect very much nearer *Helosis* than *Langsdorffia*.

There are no sclerenchymatous strands corresponding in position to those which in *Helosis* are situated outside each fibro-vascular bundle, with a cup-like form in transverse section. They occur arranged somewhat concentrically, but still irregularly, gradually decreasing in diameter and in the number of cells to the periphery.

* A. F. W. Schimper in Abh. der Natur. Gesell. zu Halle, 1880.

† Mart. Fl. Bras. fasc. 47, Balanophoreæ, p. 25.

The four fibro-vascular bundles nearest the centre are large, more or less elliptical in transverse section, with the long axis, which is vertical, occupied by the cambium. The xylem, facing inwards, consists of narrow vessels, the ends of one vessel being often bent over to join another; the longitudinal walls have reticulate-porose markings; the transverse walls are oblique, and also have porose markings. There is neither wood-parenchyma, nor spiral nor annular vessels. The phloëm consists of soft bast, narrow prosenchymatous cells, with an occasional sieve-tube occurring amongst them. The elements of the whole bundle, including the cambium, resemble those of *Helosis*, as described and figured by Eichler *. There are also three or four wood-vessels above and below the central strand.

The smaller bundles are like the larger bundles, except, as above stated, in the opposite orientation of the xylem and phloëm.

In *T. sanguinea*, Vahl, the bast of the four internal bundles is continuous round the central sclerenchymatous strand, with occasional wood-vessels here and there.

The *floral peduncle* is situated laterally on the rhizome, and its origin is first indicated by a swelling. When the bud breaks through, the ruptured cortical parenchyma forms a ring, with two to six irregular short lobes—the "volva." The successive transverse sections which I have made through the bud appear to show that it is adventitious, and formed in the cortical parenchyma. In the adult state the fibro-vascular bundles run up from the rhizome towards the peduncle, but I have not seen them actually pass from the one to the other.

The peduncle is very short, so that the capitula are almost sessile on the rhizome. It is smaller at the base than above, and is clothed with numerous imbricating scales. There are several scattered fibro-vascular bundles, some of which are arranged in an irregular ring midway between the centre and the periphery.

At the very base of the peduncle, and between the insertion of the scales, an epidermis exists, clothed with hairs of the same kind as those on the rhizome, and with a layer of sclerenchymatous cells beneath it. No other sclerenchymatous cells are to be found in the peduncle.

The obtuse *scales* are persistent, imbricate, and increase in size from the volva upwards, the lowest being 5–6 mm. broad and 6–8 mm. long, while the large upper scales are 8 mm. broad and 20 mm. long. These large upper scales are linear, and distinct in outline from the series just below, which are rotundate, the lower scales gradually becoming lanceolate. The margins of the upper scales have a torn appearance.

The scales have a single fibro-vascular bundle running up the centre through the soft-walled parenchyma. There is an epidermal layer of small dark-coloured cells, beneath which is a continuous layer of sclerenchymatous cells with walls thickened to such a degree as to leave only a small cavity in the centre. Several of the subjacent cells are also sclerenchymatous; they occur in masses 2-, 3-, or 4-deep, forming an almost continuous layer; frequently the wall on the inner side of such masses, adjacent to the soft-walled parenchyma, is also soft-walled, just as occurs in the rhizome of *Langsdorffia*.

* Mart. Fl. Bras. fasc. 47. Balanophoreæ, p. 26, t. vi. fig. 13.

There are no stomata present on the scales, or, in fact, on any part of the plant.

The flattened receptacle of the *male capitulum* contains few flowers as compared with the female capitulum. Round the circumference there are a few scales shorter than the flowers. Surrounding the base of the male flowers there are scale-like bodies of fleshy character, with the surface of the upper part papillose, which possibly correspond to the bodies on the male capitulum of *Langsdorffia*, considered by Hooker * and Eichler † to be abortive ovaries.

In the *female capitulum* the flowers are exceedingly numerous, probably as many as 4000. As they are slightly connected together, they form a continuous layer, completely covering the receptacle, which is convex. The inflorescence is centripetal. At the circumference there are scales, sometimes as long as the flowers, but generally shorter; they are probably true bracts, but none occur amongst the flowers themselves.

The tissue of the *male flower* and its pedicel is very like that of *Langsdorffia*, the cells being very thin-walled, and longer than broad. The pedicel contains a single fibro-vascular bundle, and therefore cannot be regarded as a staminal column with the tube of the perianth adnate, as Eichler has remarked for *Langsdorffia* ‡. The lobes of the perianth are reflexed in flowering. There is a distinct layer of epidermal cells with rugose markings on their outer walls; there is no fibro-vascular bundle nor any sclerenchymatous cells. The staminal column is solid, with three fibro-vascular bundles, which indicate three anthers. I have not been able to determine exactly the number of cells in each anther, as the flowers are too far advanced, but there appear to be 4, and it is evident that they dehisce by longitudinal chinks, as in *T. sanguinea*, Vahl. The pollen is subglobose.

The *female flowers* agree in appearance with those of *T. sanguinea*, Vahl, as described by Hooker §. I have not been able to trace the development of the flower, but have little doubt that the so-called "perianth" is really a prolongation of the ovary, as Eichler has shown to be the case in *Lophophytum* and *Helosis* ‖. Even after the flower has become fully developed, the perianth-like limb increases in width, especially at the base, the mouth becomes contracted and covers up the persistent lower portion of the style. This does not appear to be the result of fertilization, for in flowers which never produce fruit the same thickening occurs, so that finally they have a very different appearance from those in the flowering condition; for, instead of being cylindrical with the styles protruding, they become clavate. The flowers of the three or four rows nearest the circumference are fleshy and thicker than the rest. In proportion as the fruit ripens, the receptacle grows more convex, thus providing a greater surface for the enlargement of the fruit, while the hardened limb forms a protecting cap. The ripe fruit is similar in most respects to that of *Langsdorffia*, as described by Eichler ¶. The

* Trans. Linn. Soc. xxii. p. 41, tab. 2. fig. 4.

† Mart. Fl. Bras. fasc. 47. Balanophoreæ, p. 18, tab. 3. fig. 14.

‡ Ibid. p. 17 (note).

§ Trans. Linn. Soc. xxii. p. 43, tab. 3. figs. 10–15.

‖ A. W. Eichler, "Sur la structure de la fleur femelle de quelques Balanophorées," Actes du Congrès International de Botanique, Paris, 1867.

¶ Mart. Fl. Bras. fasc. 47. Balanophoreæ, p. 20, tab. 3. figs. 15–21.

layer of cells surrounding the ovule is converted into an oblong thin putamen, consisting of sclerenchymatous cells, elongated at the sides, short at the apex and base, differing from those in the putamen of *Langsdorffia* in having the outer wall of the same thickness as the inner. The seed fills the cavity of the putamen; the greater part of it consists of soft-walled parenchymatous cells.

"The well-developed embryo is a noteworthy character; it is a nearly globose body, minutely cellular, with no distinction of parts. It is situated in the upper end of the seed, close to what may be assumed to be the position of the hilum, and is wholly immersed in the albumen. The only other genera of the order in which a similarly developed embryo has been detected are *Cynomorium*, *Mystropetalon*, and *Corynæa*. In all the rest, in so far as at present described, the embryo is of a character wholly different from the above, and is most inconspicuous, composed of a few very large, loose, transparent cells attached to a suspensor, only to be discovered by making most delicate sections, whereas in the genera named above, though minute, there is no difficulty in discovering the embryo, when present, by tearing open the albumen, when it can be turned out entire by the point of a needle. I have said 'when present,' because Weddell found the fully-formed embryo to be of rare occurrence in *Sarcophyte* *, and I have only twice seen it in *Corynæa*, after dissecting a multitude of fruits. Eichler, indeed, states that the fruit of *Corynæa* is unknown †, probably by oversight, as I have fully described it."

The structure of the ovule agrees with Eichler's description and figure of *Langsdorffia* ‡. The embryo-sac is long, with a large oosphere just below the apex, and a protoplasmic mass sometimes filling up the space between the apex and the oosphere, probably representing the synergidæ. In some instances a very large nucleus was seen at some distance below the apex, which is doubtless the first cell of the endosperm. Between the apex of the embryo-sac and the base of the style there are many long narrow cells, forming a conducting tissue. There are two or three layers of small cells immediately surrounding the embryo sac, corresponding in form and position with those which Eichler considers to belong to the ovule, while the cells of the ovary lying outside are long and narrow.

The description of *T. malagasica*, as given above, modifies the character of the genus, as described by Bentham and Hooker §, bringing it very close to *Langsdorffia*. The following is the revised character:—

THONNINGIA, Vahl. Spadices unisexuales. Flores dioici. Fl. ♂: Perianthium e squamulis 2–3 minutis lineari-subulatis, pedicello sparsis; aut regulare triphyllum, phyllis 3 lanceolatis; antheræ 3–(5 ?), lineari-elongatæ, in columnam pedicello continuam connatæ, 2-loculares, loculis 2-locellatis extrorsum dehiscentibus; pollen subglobosum. Fl. ♀: Ovarium elongatum, anguste cylindraceum, basi interdum tumidum, cum vicinis totum coalitum aut liberum, vertice in marginem tubulosum

* Trans. Linn. Soc. p. 54 (in nota).

† Eichler in DC. Prodr. xvii. p. 137.

‡ Fl. Bras. fasc. 47. Balanophoreæ, p. 19, tab. 3. fig. 14.

§ Benth. & Hook. f. Genera Plantarum, iii. p. 236.

2–4-lobatum v. dentatum; stylus 1, terminalis, crasse filiformis, elongatus, dimidio superiore stigmatosus; ovulum in axe ovarii consitum, erectum atropum toto ambitu ovario coalitum.

Fructus flore femineo tumidior, styli inferiore parte intra ovarii tubulosum marginem persistenti, margine apicali in pilei duri speciem connivente; endocarpium in putamen tenue induratum; epicarpium carnosum. Semen endospermio copioso oleoso; embryo subglobosus, axilis interdum excentricus, ad trientem endospermii superiorem consitus.

Herba carnosa cerigera; rhizoma cylindraceum, esquamatum, tomentosum vel glabratum; volva lobato-dentata. Pedunculi brevissimi v. elongati, squamis imbricatis tecti; squamæ superiores spadicem involucrantes, persistentes. Spadices ♂ depresso-hemisphærici; ♀ hemisphærici v. subglobosi. Flores ebracteati v. bracteolis ad basim fl. ♂ minutis, ♀ stratum continuum efformantes.

III. On Brugmansia Lowi, *Beccari*.

Blume, in 1827, described a parasitic plant from Java, a near ally of *Rafflesia*, under the name of *Brugmansia Zippelii* *. For his new genus he revived a generic name given by Persoon, in honour of S. J. Brugmans, to plants afterwards placed under *Datura*. In 1829 he published an elaborate description of it, accompanied by coloured plates, in the 'Flora Javæ' †. The genus is quite distinct from *Rafflesia* in the absence of the corona of the perianth, the induplicate æstivation, the capitate genital column, and the two-celled anthers.

Beccari, in 1868, published a diagnosis ‡ of a new species (*B. Lowi*), and, in 1869, a detailed description with plates §. These plants were in bud only; and, in Hooker's monograph of the Cytinaceæ in De Candolle's 'Prodromus,' he evidently did not consider Beccari's new species quite satisfactory, and therefore placed it as a variety only of *B. Zippellii*, Blume.‖ In 1874, in a paper "Osservazioni sopra alcune Rafflesiacee," Beccari refers to the question of its being a good species ¶, mentions that he has since had opportunities of examining *B. Zippelii*, Bl., and quotes from his former paper the following passage, in which he had stated the differences:—"*Brugmansia Zippelii*, according to the figure and description given by Blume, seems somewhat smaller than *B. Lowi*, has the interior of the perigone uniformly pilose, ramentaceous, and furrowed with numerous striæ (instead of fourteen to sixteen ribs), which disappear in the ventricose part of the unopened flower; at the throat, in place of the tufts of hairs, it

* 'Bijdragen tot de natuurkundige wetenschappen,' Amsterdam, ii. (1827), p. 422.

† Vol. ii. Rhizantheæ, p. 13, tt. 4–6.

‡ Atti Soc. Ital. Sc. Nat. xi. p. 197 (1868).

§ "Illustrazione di nuove specie di pianti Bornensi," Nuovo Giorn. Bot. Ital. i. p. 84, t. 5.

‖ DC. Prodr. xvii. p. 113, 1873.

¶ Nuovo Giorn. Bot. Ital. vii. p. 74.

has fifteen linear oblong callosities, glabrous, colourless, equidistant, furrowed in the middle, concealed by the ramenta. The limb is 5-partite (6-partite in the figure), with laciniæ which have two or three furrows or fissures; the genital column is globose and less depressed, the upper part is marked with various furrows, which perhaps correspond to the number of the anthers, which moreover correspond to the number of the furrows of the tube of the perigone on which they must press in the bud; the stalk or neck of the column is more elongated; the anthers are thirty-eight to fifty. Finally *B. Zippelii* is hermaphrodite."

The question is now finally settled by a coloured drawing and an expanded flower together with buds, sent to the British Museum by Mr. H. O. Forbes. These plants he collected on the slopes of Mt. Dempo, Sumatra, at an elevation of 4000 feet.

The expanded flower is not perfect, as the ovary is wanting. It is, however, extremely interesting, since it confirms a happy conjecture of Beccari, founded on an examination of the bud, namely, that the perianth in opening splits up into "fourteen to sixteen laciniæ," instead of into five or six, as in *B. Zippelii*, Bl. Mr. Forbes's fully-opened specimen shows that the perianth splits up into sixteen lobes, and therefore as a species it is quite distinct. A transverse section of the inflexed parts in the bud shows that eight of them form a central mass, while the remaining eight alternate with them on the outside; an indication of this double series is afforded by the alternate lobes in the bud dipping beneath the others at a short distance below the apex of the bud. The lobes are connected below the bud apex by a membranous extension of the inner surface, which is reduced in the inflected portion to a narrow wing. When the flower opens, the web is split more or less between each lobe. The apical portions, which have been inflexed, are always free.

The fissures extend downwards to about the level of the top of the genital column, and this is therefore the limit of the tubular portion of the perianth. The flower opens wide and flat at this point, though the web may not be ruptured between all the lobes.

From the existence of the web between the lobes it would seem as if a tube were formed by the inflexed parts on the first expansion of the bud, leading from the exterior to the depression in the genital column. If it be so, it may possibly be connected with cross fertilization by insects. The strong fetid odour which Mr. Forbes noticed in this plant may also have some relation to the action of insects.

Beccari figures the cells of the anthers as directly superposed; in Mr. Forbes's specimens there is an appearance of alternation.

DESCRIPTION OF THE PLATES.

Plate XXXIII.

Balanophora, species of.

Fig. 1. Male plant of *Balanophora decurrens.* Natural size.
Fig. 2. Female flowers and spadicels on the receptacle of ditto. Magnified.
Fig. 3. Bud of male flower of ditto, seen from above. Magnified.
Fig. 4. Capitulum of anthers of ditto, seen slightly from above. Magnified.
Fig. 5. Male plant of *B. gigantea,* Wall. Natural size.
Fig. 6. Female flowers of ditto on the stalk of the spadicel. Magnified.
Fig. 7. Male flower of ditto, seen slightly from above. Magnified.
Fig. 8. Female plant of *B. Forbesii.* Natural size.
Fig. 9. Female flowers and spadicels on receptacle of ditto. Magnified.
Fig. 10. Male flower of ditto. Magnified.

Plate XXXIV.

Balanophora, species of.

Fig. 1. *Balanophora Zollingerii,* attached to the root of its host. Natural size.
Fig. 2. Female flowers and spadicels of ditto on receptacle. Magnified.
Fig. 3. Bud of male flower of ditto, seen from above. Magnified.
Fig. 4. Capitulum of anthers of ditto, seen slightly from above. Magnified.
Fig. 5. *B. multibrachiata,* attached to the root of its host. Natural size.
Fig. 6. Very young female flowers of ditto on receptacle, with sessile spadicels. Magnified.
Fig. 7. Bud of male flower of ditto, seen from above. Magnified.
Fig. 8. Capitulum of anthers of ditto. Magnified.
Fig. 9. Female plant of *B. ramosa.* Natural size.
Fig. 10. Female flowers of ditto on stalk of spadicel. Magnified.

Plate XXXV.

Thonningia malagasica.

Fig. 1. Female capitulum during flowering, on rhizome (*r*), showing at (*a*) the swelling where a bud is about to break out, and at (*b*) a young bud.
Fig. 2. A transverse section of the rhizome; *s*, the sclerenchymatous strands; *f*, the fibro-vascular bundles, the shaded portion being the xylem.
Fig. 3. The central portion of fig. 2, enlarged; *s*, sclerenchyma; *x*, xylem; *ph*, phloëm; *p*, parenchyma.
Fig. 4. A longitudinal section through the central sclerenchymatous strand and one of the fibro-vascular bundles; *t*, thick-walled cells of the circumference of the sclerenchymatous strand; *c*, thinner walled cells in the centre of the sclerenchymatous strand; *p*, parenchyma; *fv*, fibro-vascular bundle; *x*, xylem; *ph*, phloëm.
Fig. 5. Sclerenchymatous cells from fig. 4.
Fig. 6. Transverse section of portion of a scale; *f*, the solitary fibro-vascular bundle; *p*, the parenchyma; *s*, sclerenchymatous cells.
Fig. 7. Portion of female flower, showing embryo sac (*s*), conducting tissue (*c*), walls of ovule (*ov*), base of style (*st*).

Fig. 8. Transverse section of the pedicel of male flower, with one fibro-vascular bundle in the centre.
Fig. 9. Transverse section of a portion of the staminal column, with three fibro-vascular bundles.
Fig. 10. Ditto, higher up, when dehiscence has taken place.
Fig. 11. Pollen.
Fig. 12. Transverse section of one of the leaves of the perianth of the male flower.
Fig. 13. One of the fleshy scales surrounding the male flowers.

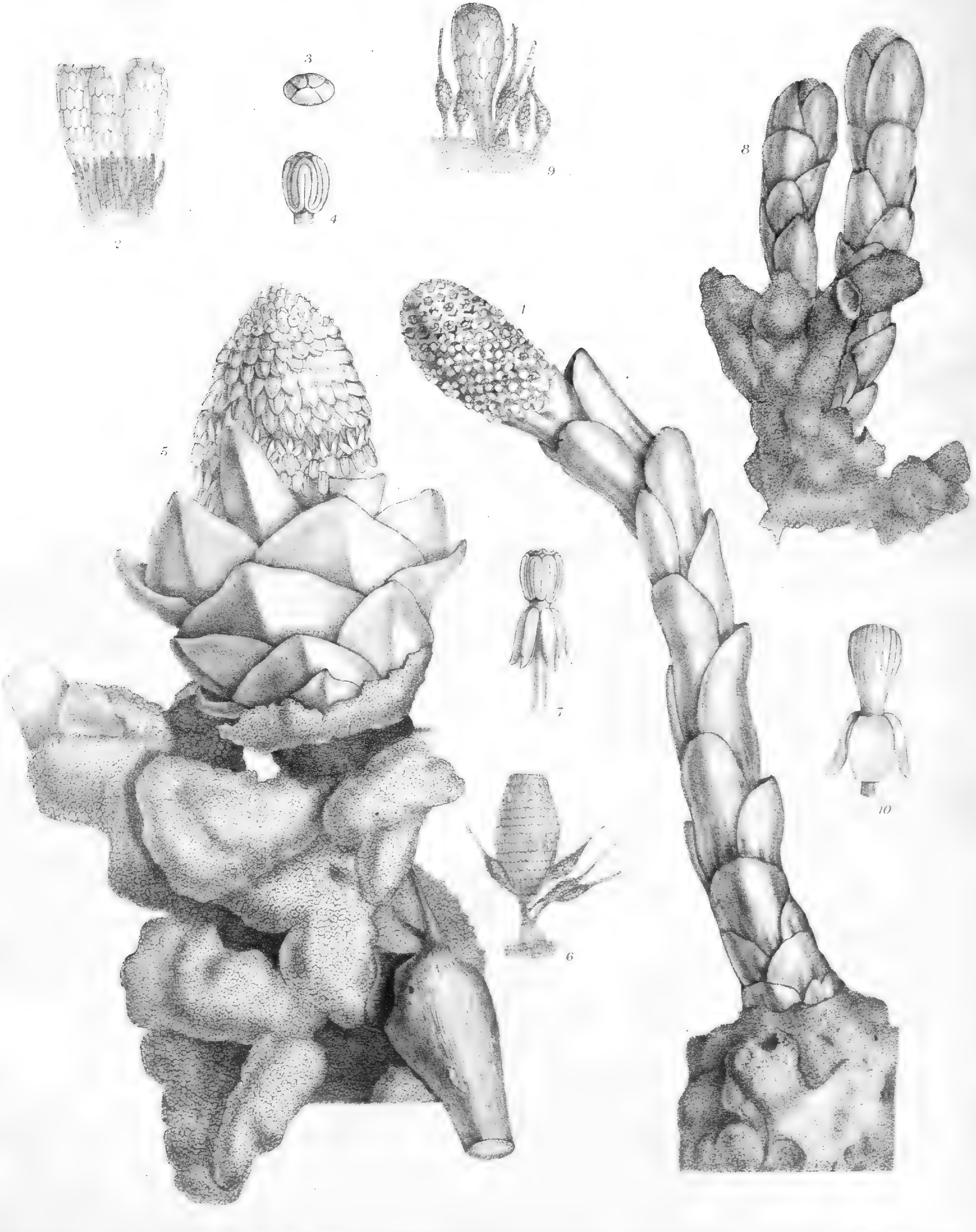
Plate XXXVI.

Thonningia malagasica (figs. 1–11); *Brugmansia Lowi*, Becc. (fig. 12).

Fig. 1. Fruit, showing the persistent base of the style (*s*), embryo (*e*), endosperm (*en*), putamen (*p*).
Fig. 2. Unfertilized flower.
Fig. 3. Rhizome with two male capitula.
Fig. 4. Male capitulum in section.
Fig. 5. Male flower.
Fig. 6. Two female capitula in fruit.
Fig. 7. Female capitulum in fruit, in longitudinal vertical section.
Fig. 8. Single fruit.
Fig. 9. Unfertilized flower.
Fig. 10. Unfertilized flower.
Fig. 11. Endosperm with embryo.

(Figs. 3–11:) From original drawings by Sir J. D. Hooker.

Fig. 12. *Brugmansia Lowi* (natural size), after a coloured drawing from the living plant by Mr. H. O. Forbes.



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1-4, BALANOPHORA DECURRENS. 5-7, B. GIGANTEA. 8-10, B. FORBESII.

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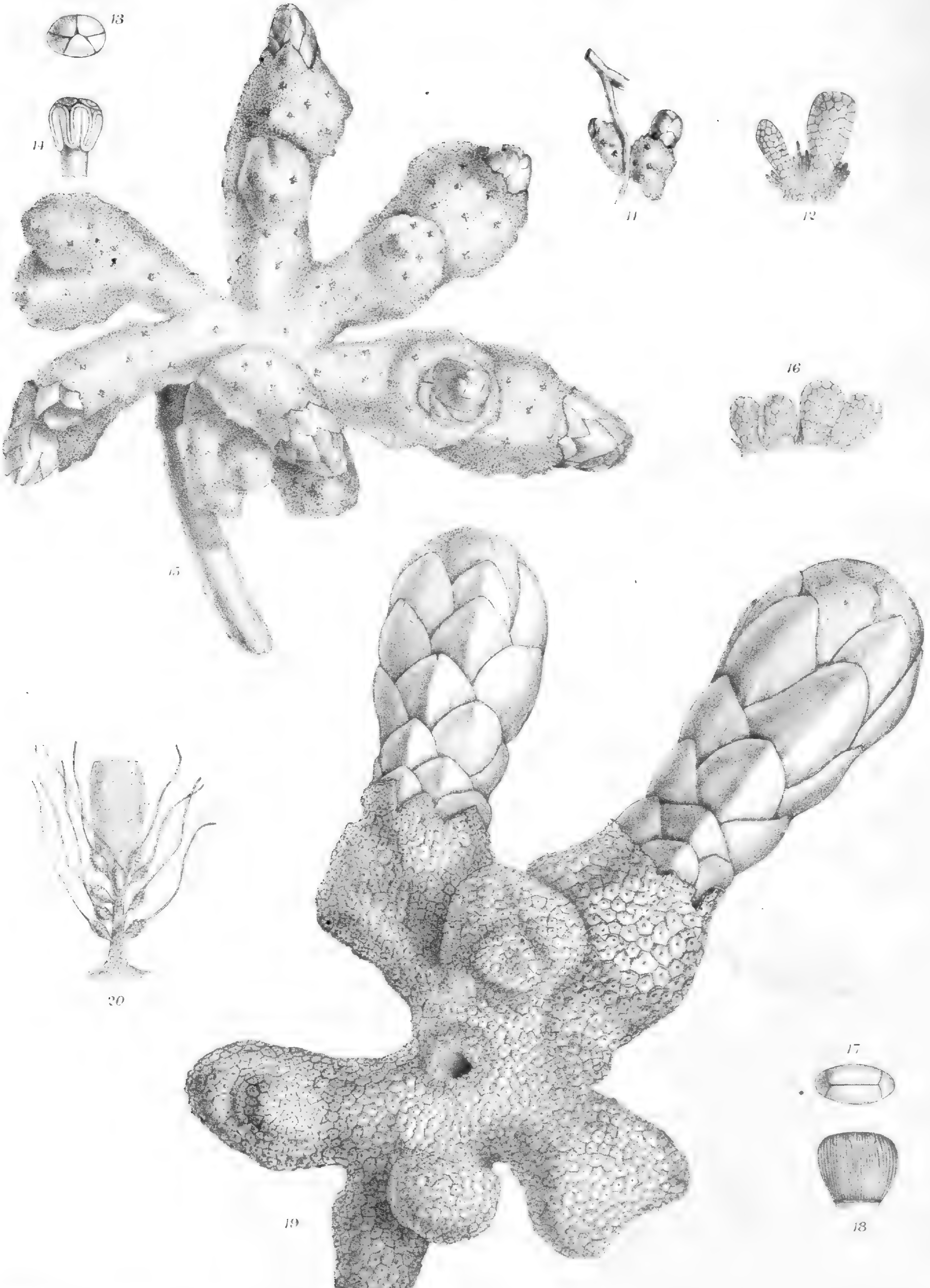

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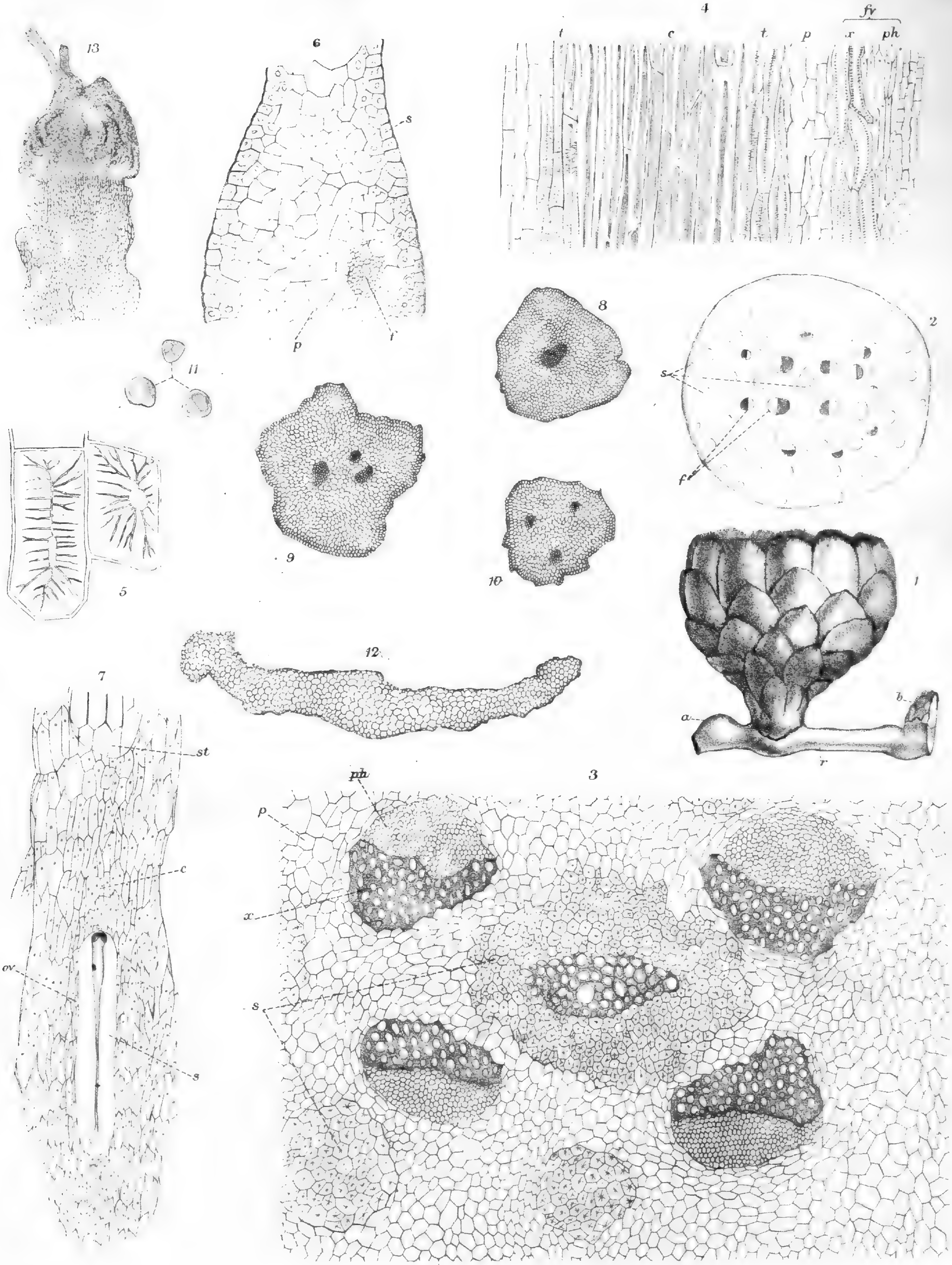
11-14, BALANOPHORA ZOLLINGERII. 15-18, B. MULTIBRACHIATA. 19, 20. B. RAMOSA.



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1,–11, THONNINGIA MALAGASICA. 12, BRUGMANSIA LOWI *Becc.*

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THE

TRANSACTIONS

OF

THE LINNEAN SOCIETY OF LONDON.

THE BOTANY OF THE RORAIMA EXPEDITION OF 1884.

By E. F. IM THURN.

(*Communicated by* Sir J. D. Hooker, K.C.S.I.)

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July 1887.

XV. *The Botany of the Roraima Expedition of* 1884: *being Notes on the Plants observed, by* EVERARD F. IM THURN; *with a list of the Species collected, and Determinations of those that are new, by* Prof. OLIVER, *F.R.S., F.L.S., and others.* (*Communicated by* Sir J. D. HOOKER, *K.C.S.I., F.R.S., F.L.S.,* &c.)

(Plates XXXVII.–LVI.)

[Read 15th April, 1886.]

I. *Notes on the Plants observed during the Roraima Expedition of* 1884. *By* EVERARD F. IM THURN.

AS was expected, the plants collected on the way to Roraima, and especially about that mountain itself, during the recent expedition and first ascent to its summit, have proved of great interest, now that they have been examined and catalogued at Kew. Several specialists have most kindly lent their aid in examining and determining these plants. While Professor Oliver undertook the bulk of the collection, Mr. J. G. Baker, besides determining a few of the Petaloid Monocotyledons, has, with Mr. G. S. Jenman of British Guiana, worked out the Ferns, Mr. H. N. Ridley, of the British Museum, the Orchids and Cyperaceæ, and Mons. E. Marchal the Araliaceæ, Dr. Engler has described a new *Moronobea*, Mr. E. Brown a new Aroid, and Mr. Mitten has named the Muscales; lastly, Dr. Maxwell Masters has supplied a note on two Passifloræ, perhaps new, but imperfectly represented. In all, fifty-three new species and three new genera have been described by these various workers.

The number of species collected would probably have been greater but for the extreme difficulty of drying plants in so excessively damp a climate as that of Roraima, and also for the fact that the other very serious labours inseparable from the direction of such an expedition greatly curtailed the time I was able to devote to the preparation of botanical specimens. As regards the number of new generic and specific forms collected, great as it is, it would undoubtedly have been much greater but for the fact (unfortunate in this respect) that my collection was made at exactly the same period of the year [November and December] at which such collecting as had been done before about Roraima had been accomplished by Sir Robert and Dr. Schomburgk and by Karl Appun*.

* The list of visitors to Roraima, other than natives, is as follows:—Sir ROBERT SCHOMBURGK, then at the head of a boundary commission, was there in 1838, and again, with his brother, Dr. RICHARD SCHOMBURGK, the present director of the Adelaide Botanical Gardens, in 1842. Both made considerable botanical collections, which were distributed, I believe, mainly between the Herbaria at Kew, the British Museum, and at Berlin. KARL APPUN was at Roraima in 1864; his collections are chiefly at Kew. C. B. BROWN, then the geological surveyor of British Guiana, was there in 1869; two Englishmen, FLINT and EDDINGTON, were there in 1877; and two others, M'TURK and

Probably no district of equally small size, after such brief and cursory exploration, has yielded greater, or as great, botanical results as has Roraima; still more probable is it that few small districts are so distinctly marked off from the country immediately surrounding them by such great and remarkable peculiarities in their vegetation. In brief, the district of Roraima is, from a botanical point of view, chiefly interesting as an oasis clothed with a vegetation distinct from that of the country which immediately surrounds it, and at the same time, also in a very marked degree, peculiar either to this special district or to this in common with a few other almost equally isolated, but widely separated districts.

I cannot devote these prefatory remarks (in which I have the privilege of introducing the list and description of my collection, so kindly prepared by the authorities above mentioned) to a better purpose than to make as emphatic a statement as I can *of the isolated character, botanically, of the Roraima district, of the probable botanical relation to certain other possibly similar districts, and of the general appearance of the very peculiar and distinct vegetation of these districts* *.

The whole area known under the name of Guiana may be likened to a wedge driven into the north-eastern shoulder of South America. Geographically, it is thus placed between Brazil on the south and Venezuela on the north; for our present purpose it will, however, be better to describe its position somewhat differently. The artificially formed political divisions of the continent for obvious reasons correspond very closely with the tracts naturally differentiated each by its own river-system. As it is along the river-systems that the migration of animals and plants chiefly occur, the customary and convenient names of these divisions therefore really correspond somewhat closely with the natural and important differences in flora and in fauna, which distinguish the narrow river-basins. Thus, as Venezuela is essentially the tract drained by the great river Orinoco, and as the northern part of Brazil is essentially the tract drained by the great river Amazon, and as Guiana, intermediate between these two, consists essentially of the parallel tracts drained by comparatively smaller rivers (of which the Essequibo, the Demerara, the Berbice, the Corentyn, the Saramacca, and the Maroni may be

---

BODDAM WETHAM, in 1878. None of these made botanical collections. DAVID BURKE, an English orchid-collector, was there in 1881, and brought home interesting living plants, among others, the South-American pitcher-plant (*Heliamphora nutans*), which has, I believe, since been distributed by Messrs. Veitch & Sons. HENRY WHITELY, an English collector of bird-skins, was there on several occasions between 1879 and 1884, and is, I believe, again there ta the present moment, but he has collected no plants. SIEDEL, a German orchid-collector, was there in April 1884, and again, with us, in December of the same year. He brought back only living plants, especially the magnificent *Cattleya Lawrenceana*, which have since been distributed by Mr. H. Sander. Of these Siedel, the only traveller with an eye for plants who has been at Roraima except in the last months of the year, assures me that the abundance of flower was much greater there in April than in December. But in the latter month the natives' Cassava-fields are in full bearing, and provision is therefore much more easily attainable.

* I use the phrase "Roraima district" as including not only the mountain of that name, but the whole of the small group of similar sandstone mountains of which Roraima is the best known, and at present the only explored member.

mentioned), so Venezuela, Guiana, and North Brazil therefore represent tracts which are really more or less differentiated from one another in their flora and fauna.

Now, as the whole of the tract under consideration (that drained by the Orinoco, the Amazon, and the intermediate rivers) rises gradually, or, more generally, by step-like ascents, from the sea-level on its east toward the tableland on its west (*i. e.* the centre of the continent), it is, of course, on this tableland that the rivers take their origin. And as, owing to the irregularity of the surface of this tableland, and still more that of its slope toward the eastern sea, it follows that each of these rivers collects its head-waters from unusually widely separated localities, so it often happens that two or more of these rivers draw some portion of their head-waters from unusually contiguous localities. Thus it is conceivable, and even probable, that any peculiar animal or vegetable forms, which may originate at one of these localities which supplies water to very divergent river-systems may distribute themselves over very wide areas by passing along the courses of the various rivers thence arising.

It happens that the rock-pillars of the Roraima group, rising some 5000 feet over the general level of the tableland, itself at that part some 3000 feet above the level of the sea, pour down from their summits streams which go to swell the Orinoco, the Essequibo, and the Amazon—in other words, the three rivers respectively of Venezuela, Guiana, and Brazil. Now, as has been already mentioned, the flora of Roraima is of a very remarkably peculiar character. A most interesting question still awaits solution, namely, the relation of the flora of Roraima to the floras of Venezuela, Guiana, and Brazil.

No answer, I say, has yet been attempted to this question; nor can I pretend to suggest any. I am, however, able here to offer, as data to be considered in the question, some very general account of the flora of Guiana, and a rather more special account of the flora of Roraima in its relation to that of Guiana.

Guiana, as has been said, rises gradually from the east toward the high tableland of the interior of the continent. Instead, however, of thus placing ourselves in imagination on its sea-coast and looking westward up its gradual slope, let us imagine ourselves on the tableland on Roraima, and that we are looking eastward down toward the sea. Were such a bird's-eye view really possible, we should find that the tableland, or savannah, as it is there called, is an open treeless country, its elevated surface hardly anywhere level, but swelling up in many hills, and even into some mountain-ranges. We find that only along the courses of the rivers, or in the other lower parts where water has accumulated in some form, are there more or less extensive belts of trees, and that, on the savannah itself, even these trees are, considering that we are in the tropics, of no great size. Further eastward, on the lower part of the slope toward the sea, where the rivers have already grown wider and approached each other more nearly, the trees are more numerous and larger. Still further eastward, lower down the slope, the belts of trees, each pertaining to its own river, have widened with the rivers, till they have approached and then joined each other; here the trees are of yet larger size. At last, at the bottom of the slope, between its foot and the still far distant sea-waves, the wide tract of alluvial soil which has been deposited, having either been brought down by the rivers or cast up from the sea, is virtually entirely occupied by the omnipresent forest of trees, which have there attained their true gigantic tropical size. If we except certain small patches of very swampy open land within this forest of the alluvial tract, locally called "wet savannahs," all is forest except the very narrow strip of land actually washed by the waves, and not even that toward the north.

Very different and distinct floras characterize the parts of Guiana thus variously conditioned, though, naturally, a certain number of species are common to all three.

Where the narrow sea-washed strip has been artificially disafforested, a generally dwarf and weed-like flora prevails, very rarely consisting of non-indigenous plants.

Within the forest, after the generally great height of the trees and often the abundance of palms, perhaps the most noteworthy features of the vegetation, are in the first place, the great scarcity of mosses, herbage, and low-growing plants, especially of any with conspicuous flowers, and the consequent barrenness of the soil, which is relieved by only a few scattered ferns, ginger-worts, Caladiums and other aroids, Dieffenbachias, Cyperaceæ, and other shade-loving plants; and, in the next place (though this is hardly discernible from below), the abundance of the flowering creepers and epiphytes spread over the matted tops of the dense and lofty trees. The representatives of the low-growing flowering plants of the thinner, lighter woods of temperate climates have here, in this dense shade of the tropical forest, to send their immensely long, flowerless, creeping stems up some one or even two hundred feet, to reach above the highest tree-branches, before they can break into bloom. Only as semiaquatics along the river-side there are a few showy-flowered dwarf plants.

Quite different again is it on the savannahs, where, among the grasses which naturally form the chief vegetation, are scattered a considerable number of bright-flowered dwarf plants; though even here the abundance of bloom very rarely reaches the extraordinary development which it often does in the meadows of temperate climates. Rather striking, too, is it that on these savannahs many of the bright-flowered plants, unlike those of temperate meadows, are here also true climbing-plants, leguminous chiefly, and various species of *Echites,* though their stems, instead of climbing far and high over giant trees, here only ramble weakly over the short grasses.

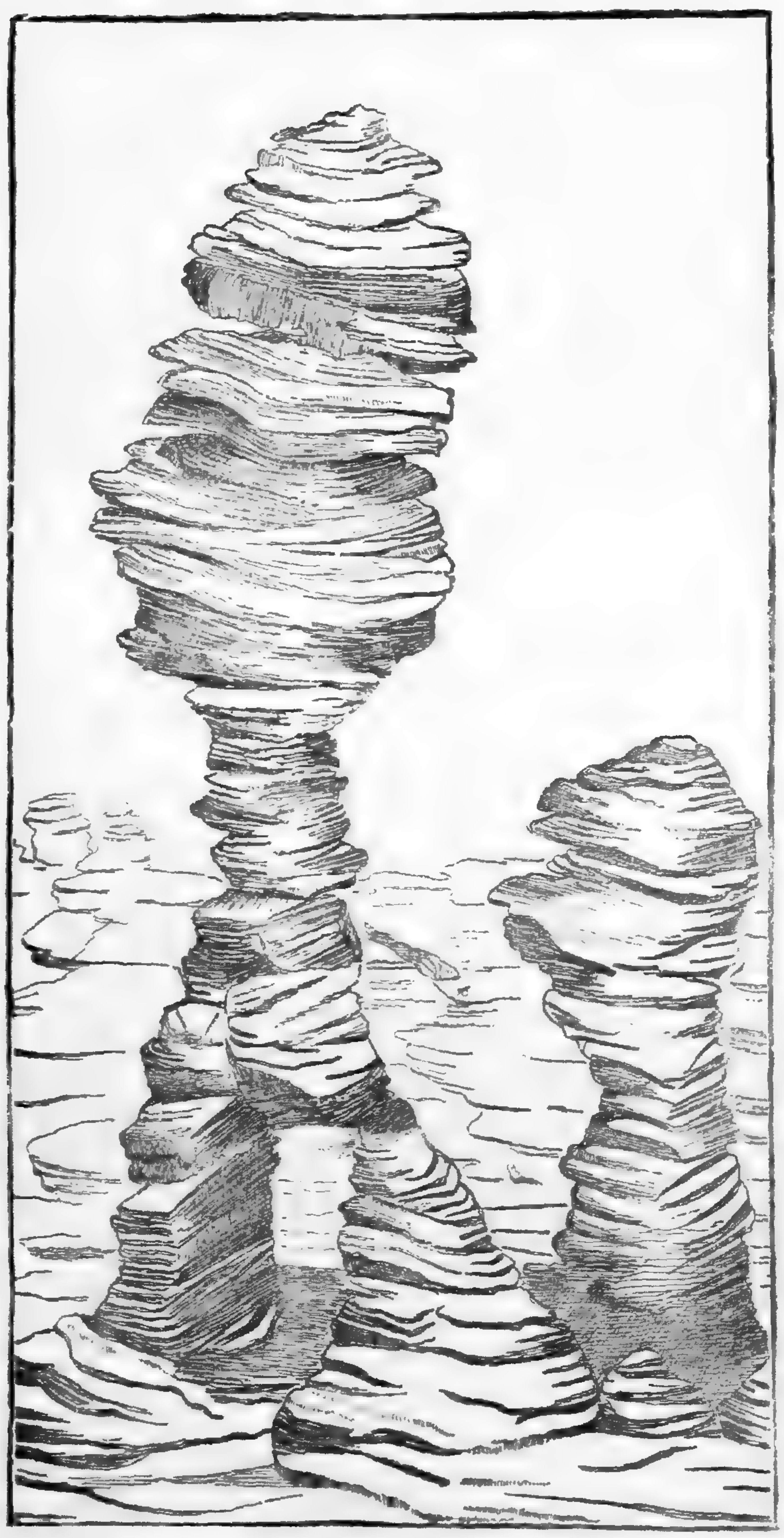
In each of these distinct floras of the coast, the forest, and of the savannah, the number of species is of course great; but in each separate district the species characteristic of it are, as a rule, remarkably widely and evenly scattered throughout its extent. For example, within the forest-district probably by far the larger number of species have an unbroken distribution throughout its extent, and of the remaining species most have an unbroken distribution throughout the district from north to south; though they may be limited from east to west, according, that is, to the greater or less distance from the sea or to the higher or lower position on the general upward slope of the country. On the savannah, the level of which probably corresponds more or less closely with the general level of the main tableland of that part of the continent, the distribution of the main species is still more even and universal. On almost every part of the savannah certain grasses, dwarf shrubs, and herb-like plants, form the dominant vegetation. Yet a few remaining parts are marked by the occurrence of certain distinct and, so to speak, localized species, which are scattered more or less widely among the more ordinary forms. Again, a very few other parts are still more distinctly marked, and made very distinct areas, by the more or less complete absence of the ordinary forms, and the substitution there of an entirely new and generally very distinct set of species. These areas with a few localized species, several of which were passed by us on our way to Roraima, and still more these areas of distinct vegetation, of which the Kaieteur savannah which we traversed, and especially Roraima itself, are remarkably fine examples of the utmost botanical interest.

A few notes must first be given of the species here described as localized. It is to be remembered that these notes were made during a single walk, long as it was, through a country otherwise almost absolutely unknown; so that though these species were noticed by me because I saw them either only in one spot, or at least in very few spots—*i. e.* I passed through either only one distinct group or through very few such groups of them—yet it is, of course, impossible to assert that many other such distinct groups do not occur wherever the requisite soil and other circumstances permit.

A considerable number of such localized species occur on tracts where the soil is of so peculiar a nature as to have earned a special name for such places from the natives, who call them *Eppellings*. This name is applied by the Arekoonas to certain tracts in which the underlying very soft sandstone is overlaid by a coating of hard dense and dry mud, or, in some other cases, of hard conglomerate. Wherever, as is often the case, this hard-mud surface is unbroken, it resembles an asphalt pavement, or, perhaps, rather a floor made of hard-beaten earth. But this curious earth-surface overlies hill and dale alike—is, therefore, not often level. Wherever, then, there has been the slightest crack in its surface, rain-water gathers, and, having once obtained a lodgment, eats away and enlarges the crack. The result is an eppelling surface, which, instead of being like an asphalt pavement, is like a pavement formed of irregularly-shaped and scattered flag-stones. But, again, the mud-layer which overlies the eppelling being by no means thick, whenever this has once been indented, as just described, by many cracks enlarged by water, these cracks are soon engraved through the mud-layer down to the soft sandstone below; and, when this has once occurred, the sandstone thus exposed, which yields to the action of the water even more readily than does the hard mud, is rapidly worked out. In this way the eppelling is made to assume the form of a number of blocks of sandstone, often pillar-like. Each of such blocks is capped and protected by a patch of the original hard earth, or, in other cases, of the original conglomerate. (See woodcut, fig. 1, p. 254.)

Now, where the original eppelling surface is unbroken, in which state we have compared it to an asphalt pavement, it is as entirely devoid of vegetation as such an artificial pavement would be. But where the surface of the eppelling has reached its furrowed stage, a few plants find lodgment, chiefly certain orchids and other such plants, of which the roots are of such a nature that, in the dry season, when the furrows are waterless, the whole plant shrinks into complete rest, and even in some cases loses its roothold, and is blown about on the surface of the eppelling until the next rains come, when it again throws out anchor-like roots into some new furrow. One orchid of this wandering tendency is a *Catasetum* (*C. cristatum*? [No. 148]); another is the new and very beautiful *Oncidium*, named and described by Mr. Ridley in the appended list as *O. orthostates* [No. 12]. Sometimes, too, in this same state of the eppelling, especially where such ground occurs on the brows of exposed hills, shrubs of considerable size find anchorage in the furrows and flourish. One such hill-top which we passed was made very beautiful in this way by a large and isolated patch of the large rosy-flowered *Bonnetia sessilis*, Benth. [No. 11]. In another similar place we passed through a distinct patch of the compact *Stifftia condensata*, Baker [No. 110]. And more than one such place was distinguished by thickets of *Gomphia guianensis* [No. 15].

Fig. 1.



Rock-pillars on the summit of Roraima.

Lastly, as regards the eppellings where the furrows of these places have been worked down into the sandstone, and have been much enlarged, the deep ravines and pits of all sizes thus formed, though bare of vegetation wherever the process of water-washing still continues in violent action, where this action has ceased owing to the stoppage of the outlet, or has become much moderated, are comparatively thickly clothed with vegetation.

Another remarkable localized plant, though not occurring on an eppelling, was the beautiful *Aphelandra pulcherrima*? [No. 14]. It has already been said that, even on the otherwise open savannahs, more or less extensive belts of forest often clothe the sides of the narrower parts of the valleys through which the rivers run. One such place we came to, where, after crossing the Ireng river and the low watershed which there separates that river from its tributary, the Karakanang, we were descending toward the level of the last-named river. It was here that, in a somewhat extensive wood of which most of the trees were common species of *Cassia*, we found the dense, shrubby underwood to consist almost entirely of this beautiful scarlet-flowered *Aphelandra*.

Throughout a small tract on either side of the Ireng river, where the ground was almost entirely covered by a gravelly layer of shattered conglomerate, a very beautiful herb, with flowers of an intense violet-blue—a very rare colour in Guiana—was common, and pleasantly reminded me of an English "viper's bugloss." It was *Stachytarpheta mutabilis*, Vahl [No. 1], which seems to me to correspond to my description of a localized species.

Again, between the Ireng and the Cotinga rivers, there grew in abundance, and evidently as a native, a plant [*Furcræa gigantea*] which, common enough near the coast of Guiana in cultivation, and even as an evident escape from cultivation, is nowhere else, as far as I have seen in many wanderings, wild in that colony.

Lastly, as regards localized species, I would mention several dwarf bamboos, none of which, unfortunately, did I succeed in finding in flower. One of these, a wonderfully graceful species, appears to me peculiar, in that it grows in dense thickets on the open savannah. This was on the Ireng river, and more sparingly onward from there toward the Cotinga. Another of these bamboos (*Chusquea* [sp.?], No. 18), I think the most graceful plant I ever saw, occurred sparingly, and only in one spot, on the Arapoo river close to the village of Tooroiking. A third bamboo, a climbing form (*Guadua*) [No. 359], occurred to me first on the same river, but is much more common on Roraima itself, and should perhaps be spoken of in connection with the vegetation of that mountain.

Turning next to the areas of distinct vegetation, the first to be mentioned is that of the Kaieteur savannah *. This is certainly a very remarkable place, with an equally remarkable vegetation. It is an open space, some two miles long by one across, in the heart of the ordinary dense forest, and some four days' journey on foot from the nearest open country. It has been said that the descent from the tableland of the interior toward the sea is not a gradual slope, but occurs chiefly in a series of step-like descents. These descents are generally of no great individual height; but that of the Kaieteur takes the form of an almost abrupt cliff—at the Kaieteur fall itself it is an actual cliff—of between seven and eight hundred feet in height. The Potaro river, rising apparently from the neighbourhood of, but not actually on, Roraima, after an unknown upper course of considerable length, runs along one side of the almost perfectly level Kaieteur savannah, and precipitates itself, at the east end of that savannah, down the sheer descent of 800 feet. The savannah itself is virtually a flat exposed rock, many parts of which are as absolutely bare as a London pavement. This rock is sandstone, which, as in the eppellings (indeed it probably is one, but of unusually unbroken surface) is capped by a harder material, a layer of conglomerate. Just as the hard surface of the eppellings cracks, and eventually affords roothold in the fissures thus made for plants, so the hard conglomerate covering of the Kaieteur savannah has cracked, and in many of the fissures thus produced has given harbourage for plants. Some of these latter fissures have gradually been filled up by the accumulation of vegetable matter; others remain still open. On this savannah, however, the fissures are larger than is commonly the case in the eppellings—are, in fact, often very long but generally narrow fissures. Many of these are now entirely occupied by shrubs and dwarf trees. The lines of these masses of vegetation, necessarily following the direction of the fissures,

* Some excellent "Remarks on the aspect and flora of the Kaieteur Savannah" were published by my friend Mr. G. S. Jenman in 'TIMEHRI' vol. i. (1882) p. 229.

present, in most remarkable degree, the appearance of the well-marked designs laid out by a landscape-gardener; the whole effect is like that of an artificial garden, with regular groups of shrubs separated by wide paths and roads of clean bare rock. Moreover, it is not only in the fissures that plants grow on this savannah. As on the eppellings, so here too, a certain number of plants find sufficient foothold in the vegetable accumulations in the slight depressions in the conglomerate sheet before these have been engraved deeply enough to leave the sandstone exposed and to make regular fissures.

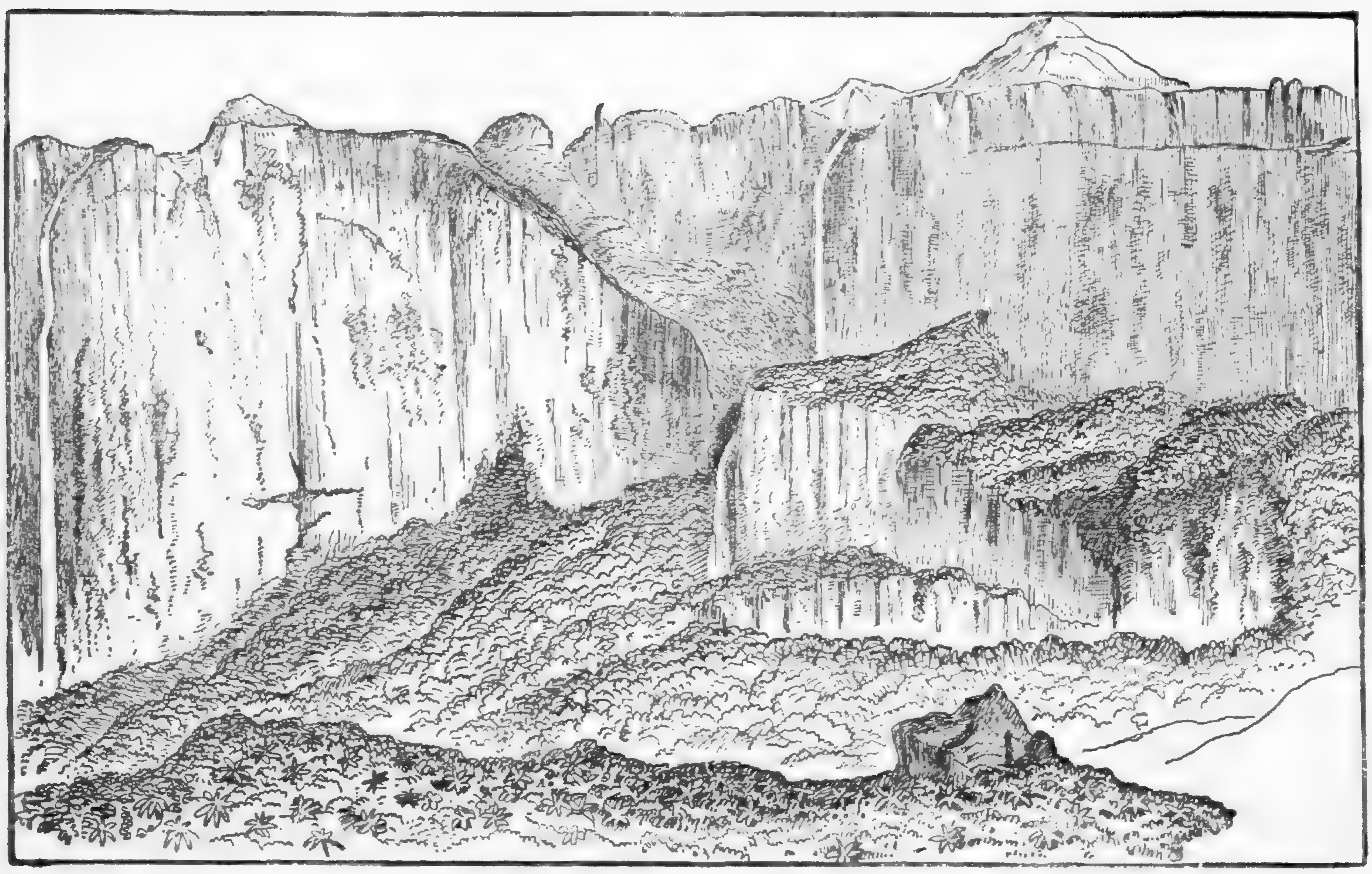
But not only is the arrangement of the vegetation of the savannah thus very remarkable; the plants composing this vegetation are also individually of great interest. As might be expected, very few of them occur in the forest which everywhere, and for a great distance, surrounds this strange open space. Much more remarkable is it that very few of these plants occur on the nearest savannah, nor, indeed, on the general savannah-land of the interior. And, most noteworthy of all is it, a very large number of these peculiar plants of this isolated savannah occur, often with slight but interesting differences, on Roraima.

By far the most striking, as it is also the most abundant, plant on the Kaieteur savannah is a huge aloe-like Bromeliaceous plant, *Brocchinia cordylinoides*, Baker, which was gathered there by Mr. Jenman and myself some years ago, but which was, until the Roraima expedition, unknown elsewhere. This gigantic plant, so striking as to compel notice even from the most unobservant traveller, is ranged in enormous numbers on the Kaieteur savannah, and indeed makes, to a large extent, the strangeness of that strange scene. There the height of a full-grown specimen, under favourable circumstances, is about 14 feet, and, in the older specimens at least, the crown of leaves is supported on a tall bare stem. It seems also there to flower abundantly. We shall see that the plant occurs, but with slightly different characters, on Roraima. Moreover, at the Kaieteur, in the axils of the leaves of this *Brocchinia*, and only in that position, grows a very remarkable and beautiful *Utricularia* (*U. Humboldtii*, Schombk.), with flower-stems 3 or 4 feet long, supporting its many splendidly large violet flowers. This plant too we found on Roraima, and with slightly different characters from those which it exhibits at the Kaieteur. Another remarkable and distinct plant on the Kaieteur savannah is a low-growing *Brocchinia* (*B. reducta*, Baker), also previously known only from there, and may be roughly described as resembling three or four sheets of yellowish-grey foolscap paper rolled loosely one round the other, the whole standing on one end of the roll. This plant I did not observe on Roraima, though I feel convinced that it will one day be found there; but I did see it, in very considerable quantity, in one small district about halfway between the Kaieteur and Roraima. Only one other plant common, but with a difference of form, to the two districts can be mentioned here. Mr. Jenman found at the Kaieteur a very striking new *Moronobea* (*M. Jenmani*, Engl.); and I found on Roraima another very remarkable congener (*M. intermedia*, Engl., No. 337), of which its describer says that it is intermediate between *M. riparia* and *M. Jenmani*.

In short, the Kaieteur savannah and Roraima may be regarded as two isolated areas marked by a very peculiar vegetation, which vegetation is, however, to a noteworthy extent, common to the two.

Before referring to the district of Roraima, I may mention that, if I may judge from the reports of the natives, and of the one or two white men who have been there, savannahs occur curiously like this very remarkable example at the Kaieteur (1) above Amailah fall on the Curiebrong river, a tributary of the Potaro, (2) above Orinidouie fall on the Ireng river, and (3) above a certain very large fall which exists (I have myself heard the roar of its waters) on the Potaro, about two days' boat journey above the Kaieteur. In each of these places the large and not easily mistakable *Brocchinia cordylinoides* is credibly said to occur; and it seems highly probable that with this some of the other, but less conspicuous, plants of the Kaieteur occur also on these other savannahs. In short, it may very probably be that each of these reported fall-savannahs is a distinct area, parallel and similar in vegetation to the Kaieteur savannah and to Roraima. In passing it may also here be noted that apparently a *Brocchinia*, similar to *B. cordylinoides*, occurs on the Organ Mountains, near Rio, in Brazil, reached by Gardner in 1837, and that in the axils of its leaves occurs a *Utricularia* (*U. nelumbifolia*, Gard.) which, to judge from Gardner's passing descriptions, must be strikingly similar to *U. Humboldtii* as it occurs on the Kaieteur savannah. Possibly

Fig. 2.



View of the south-east face of Roraima, showing the waterfall and ledge of ascent.

the Organ Mountains, too, resemble in some of their vegetable features the Kaieteur savannah and Roraima *.

* Gardner's description of the vegetation of the Organ Mountains (see his 'Travels in Brazil,' London, 1849, pp. 50–52, 402–403) reads extraordinarily like an account of the vegetation of Roraima. The height of the two elevations is about the same, but the Organ Mountains consist almost exclusively of granite, not, as Roraima does, of sandstone.

Let us now pass to the consideration of Roraima itself as an area of distinct vegetation; and in so doing a few words must first be said as to the physical features of the mountains.

Roraima is one (certainly the best known, perhaps really the most remarkable) of a group of pillar-like sandstone mountains capped with hard conglomerate, which group is, it seems to me, identical in nature and origin with the groups of sandstone pillars, capped with conglomerate or hardened mud, of the eppellings already described. In short, Roraima and its fellow mountains seem to be an eppelling on a gigantic scale. Some notion of how large this scale is may be gathered from the fact that Roraima itself, one pillar of the group, is almost exactly four miles wide along its south-eastern face, and is apparently seven or eight miles long from south to north, and that its height is some 5000 feet above the general level of the plain from which it rises.

This 5000 feet of height, it must be explained, is made up of a sloping base, the pediment of the pillar, of about 3000 feet, which is surmounted by the more strict pillar-like portion, 2000 feet in height. The plateau on top of the pillar is a very slightly, almost imperceptibly, hollowed basin, four miles wide by some seven or eight long, over which are scattered innumerable single rocks and piles of rocks, the largest of which are apparently some eighty or ninety feet in height. The sloping basal part of the mountain is, everywhere but toward the south-east, covered by dense, but not lofty forest; while on the south-east a considerable portion of it (which portion does not, however, extend up to the foot of the actual cliff) is treeless and grass-covered. The cliff itself is bare, but for a comparatively few mosses, ferns, grasses, and trailing plants clinging closely to the rougher parts of its surface, especially where the many waterfalls trickle down the rock-face, and for the dwarf shrubs, ever dwarfer and more alpine in character toward the top, which have found a lodgment on the few transverse ledges which break the evenness of the surface. The hollow basin at the top of the pillar is, wherever a little soil has accumulated in the depressions of the bare rock which constitutes the greater part of its surface, clothed with a dwarf herb-like vegetation of most remarkable appearance, consisting largely of various species of *Pæpalanthus*, a *Drosera*, a few terrestrial orchids (these not very conspicuous in flower), a remarkable low-growing aloe-like *Abolboda* of which I shall have more to say hereafter, various ground-clinging shrubs of alpine *Vaccinium*-like character, and of a very few single shrubs, all of one species (*Bonnetia Roraimæ*, Oliv., n. sp. [No. 330]), of larger growth, even though this is but some three feet high.

Nor in this brief sketch of the physical features of Roraima in their bearing on the vegetation is it possible to avoid mention of the great moisture of the atmosphere which surrounds the mountain. The shallow basin of the upper plateau always holds much water, and probably at times is almost full; the sides of the cliff are ever moistened by the innumerable rills and streams poured down from the plateau above on to the sloping base; and this basal portion itself is, on the more level undulating parts of its exposed surface, a mere spongy swamp, while in its forested parts it is traversed by almost innumerable rills hastening down to join the large rivers of the plain below.

When dealing with the vegetation along our line of march to Roraima I pointed out that I could only pretend to speak of the plants actually along that line; in now dealing with the vegetation of Roraima itself I can only speak of that of the south-eastern side of this mountain, which alone I was able to examine closely. We spent nearly a month on this side, where it is treeless, savannah-like, and swampy, and we climbed to the top of the mountain by a ledge running obliquely up the south-eastern face of its cliff (see fig. 2, p. 257).

It was not till we reached the top that we saw the most remarkable features in the wonderful plant-life of this very distinct area of vegetation. Even while only approaching the base of the mountain (which for convenience of description I will take to be marked on the south-eastern side by the bed of the Kookenaam river), and while we were still far off, we met for the first time with plants which we afterwards found commonly on Roraima, the outposts, as it were, of the remarkable group of plant-forms centred on Roraima. From the moment when the first of these distinctive plants of the mountain was met with till the moment, some weeks later, when we reached the top, we ever travelled onward into a more and more peculiar flora.

Our discovery, on the savannahs a full day's journey from Roraima, of the first outpost of the vegetation of that mountain was a very distinct event. We found a well-marked dense patch, perhaps some 40 yards in diameter, of *Abòlboda Sceptrum*, Oliver, nov. sp. [No. 312], a compact and dwarf, yucca-like plant, with a rosette, perhaps a foot and a half in diameter, of most acutely needle-pointed leaves. This plant appeared again in patches once or twice before we reached Roraima, and formed much of the turf, as it were, both of the savannah slope of the base of that mountain and also of the top. It was, whenever it appeared, a constant source of annoyance and of danger, not only to the naked feet of my Indian companions, but also to my own canvas-clad feet. Luckily a rumour which in some way spread among us that these rosettes of vegetable bayonets were poisonous, after causing some rather comic alarm, proved groundless. Where we first found the plant, as also on the sloping base of the mountain, it was out of flower and, though its withered flower-stems were extant, was already seedless; but on the top we found it in full and striking flower. From the centre of the rosette of leaves rises a single stem, perhaps 18 inches in height, crowned by a very regularly formed whorl of dependent yellow flowers. The general appearance—the facies, to use a term recognized, I believe, by botanists—was remarkably like that of the yellow form of the Crown Imperial (*Fritillaria imperialis*). For the botanical description of this interesting plant, as indeed of all the other new plants of which I shall attempt to describe the facies, I must refer to the list carefully worked out at Kew *.

After passing the first station of *Abolboda Sceptrum* till we reached the actual foot of Roraima, at the bed of the Kookenaam river, we continued through a country over which, though it was still furnished chiefly with the ordinary savannah vegetation, were scattered a few, indeed as we advanced an ever-increasing number of new plants. Across this tract, about halfway between the station of *Abolboda* and the Kookenaam, runs the Arapoo river, which, falling down from Roraima, has its course marked in a pronounced

* It may here be mentioned that three volumes of admirable original sketches of British Guiana plants by (Sir Robert ?) Schomburgk exist in the Herbarium of the British Museum. Among these sketches are to be found many Roraima plants, and among others *Abolboda Sceptrum.*

way by plants characteristic of that mountain, such as *Marcetia taxifolia* [No. 68], *Cassia Roraimæ*, Benth. [No. 71], *Dimorphandra macrostachya*, Benth. [No. 39], *Meissneria microlicioides*, Naud. [No. 174], *Calea ternifolia*, Oliv. [No. 27]. To me the most interesting plant on this river was a very beautiful little slipper-orchid (*Selenipedium Klotzschianum*, Reichb. f. [No. 31]), which grew in the moist gravel of the river-bed, where the plant must frequently be under water. This plant we also found in great abundance on an island in the Cotinga river, on another in the Roraima river, and on a small creek, called Aroie, a tributary of the Cotinga. Naturally the Arapoo river, as are its fellows flowing from Roraima, is an artery allowing of the dissemination of the plants of that mountain.

At last we reached the Kookenaam river, at the village of Teroota, at the base, that is, of Roraima. Even beyond the bed of the river, for some distance up the slope of the mountain, the tract of ordinary savannah vegetation still continues, its characteristic plants ever becoming more and more mingled with plants belonging to the Roraima flora, till the very distinctly marked zone of strictly Roraima vegetation is reached.

The course of the Kookenaam river, where it flows through the tract of neutral vegetation—vegetation, that is, not yet deprived of ordinary savannah plants, and not yet composed exclusively of Roraima plants—is, as was the course of the Arapoo river already described, very well defined by the large number of Roraima plants clustering on its banks. Among these may be mentioned various shrubs, *Ilex Macoucoua*, Pers. [No. 75], *Dipteryx reticulata*, Benth.? [No. 73], *Myrcia Roraimæ*, Oliv. [No. 74], and another species close to *M. Kegeliana*, Berg [No. 82]) which in places fringe the banks of this stream, and are also characteristic of the upper, proper flora of the mountains. Along the banks of this river, after its emergence from the mountain, grows in the peaty soil at the water's edge a very beautiful and sweet-scented white orchid (*Aganisia alba*, Ridley [No. 360]), and on the more rocky parts of the bank a very remarkable red passion-flower [No. 84], with panicles of many pendent flowers, each panicle having the appearance—the *facies*, to use that ugly but convenient term again—of a spray of fuchsia-blossom *. It was here, too, in the deep cuttings made by the river and half filled up with huge blocks of stone which are now overgrown with gnarled trees and shrubs, that one of the most famous of all Roraima plants grows—*Cattleya Lawrenceana*, Reichb. f. [No. 80].

This *Cattleya* is doubtless the one collected by the Schomburgk brothers, and enumerated by Richard Schomburgk as *C. pumila*; for it appears to be the only representative of this genus occurring on this side, at least, of Roraima, and this was the only side visited by the Schomburgks. It grows apparently not high up on the mountain, but on the gnarled tree-trunks, close to the water, in the clefts through which the Kookenaam and some of its small tributary streams flow, at a height of about 3700 to 4000 feet above the sea. At the time of our visit, Mr. Siedel, an orchid collector, having set the natives to work to collect this plant for him, I have seen ten or twelve of these people come into

* This passion-flower is well figured in Schomburgk's drawings, of which mention has already been made.

camp, afternoon after afternoon, each laden with a basket (a good load for a man) full of these lovely plants, many of them then in full flower. One day I myself, having gone down to the Kookenaam to bathe, gathered, just round the small pool I chose for that purpose, two most glorious clumps of this orchid, the better of the two having five spikes of flower, of which one bore nine, each of the others eight, blossoms—in all forty-one of some of the largest and finest-coloured *Cattleya*-flowers ever seen, on a single small plant, the roots of which easily lay on my extended hand *.

Before now dealing with the plants actually of Roraima, it will be convenient to say a few more words as to the form of this south-eastern face of the mountain (woodcut, fig. 2).

From the bed of the Kookenaam at Teroota (3751 feet) the mountain slopes, somewhat gradually though of course not evenly, upward for a distance of about three miles, till a height of 5000 feet is attained. This last-mentioned point is that to which a considerable number of the plants belonging to the ordinary savannah vegetation of Guiana ascend †. From this point the mountain rises, at first somewhat more abruptly and then again more gradually, so as to form, as it were, a terrace about midway up the slope. The upper level of this terrace, which lies at a height of about 5400 feet, is almost everywhere swampy, though here and there a few rocks crop out. This is the place so enthusiastically described by Dr. Schomburgk, on account of the extraordinary richness of its vegetation, as a "botanical Eldorado;" and it was here too, just within the forest which edges this swamp, that we built our house and made our headquarters. It is to this point that the open savannah extends; for above it all is more or less densely forested. Between this swamp, lying along its terrace, is a ravine, and again, beyond this ravine, in which it must be remembered that the forest begins, the mountain slopes up very abruptly to a height of about 6500 feet, to the base, that is, of the actual cliff. In the accompanying diagram (woodcut, fig. 2, p. 257) all up to the ravine is distinguished as the savannah-slope; all above, to the base of the cliff, as the forest-slope. It should also be noted that the forest-slope is not uniformly clad with trees. The lower part is densely wooded, covered, as it were, by dense jungle; next comes a belt of bush, rather than of jungle; while still higher, just under the cliff, the masses of rock which have fallen from above lie like a moraine, on which are scattered sparse trees, the low, wide-spreading branches of which interlock in a remarkable way ‡. The actual face of the cliff is, of course, bare; but wherever ledges run up for any distance these are often tree- or bush-clad; and the one ledge which runs right up to the top, the one by which we ascended, is bush-clad to a point about two-thirds up, then bushless but plant-covered.

In the ascent from Teroota up to about 5000 feet (nearly up, that is, to the commencement of the El Dorado swamp) we met with many plants new to me scattered among the

* Full descriptions of this *Cattleya* have been given in the 'Gardeners' Chronicle,' 1885, vol. xxiii. pp. 374, 375, and vol. xxiv. p. 168.

† The most conspicuous of the few plants of the ordinary plain which ascend above this point are:—*Polygala hygrophila*, H. B. K.; *P. longicaulis*, H. B. K.; *P. variabilis*, H. B. K.; *Sida linifolia*, Cav.; *Drosera communis*, A. St.-Hil.; *Pleroma Tibouchinum*, Triana; *Sipanea pratensis*, Aubl.; *Pectis elongata*, H. B. K.; *Gnaphalium spicatum*, Lam.; and *Centropogon surinamensis*, Presl.

‡ This moraine-like part of the slope is curiously like the well-known "Wistman's Wood" on Dartmoor.

usual savannah plants. Conspicuous among these were three orchids, two growing on bare pebble-covered ground, the third on the huge boulders scattered over the slope. The two former were *Cyrtopodium parviflorum*, Lindl. [No. 55], with its handsome spike, often eighteen inches high, of many yellow and purple flowers, and the delicately beautiful white-flowered *Kœllensteinia Kellneriana*, Reichb. f. [No. 61], which latter grows also on the Kaieteur savannah. The third of the above-mentioned orchids was the curious *Masdavallia brevis*, Reichb. f. [No. 286], with flowers more remarkable than beautiful. Another striking new plant also growing on the boulders of this part of the slope was a remarkably handsome and large *Puya* (?) [No. 45], with flowers of a magnificently deep indigo-blue—a colour so rare in the tropics. This *Puya*, Mr. Baker tells me, is probably a new and interesting species, but the dried specimens of it which I deposited at Kew are unfortunately not sufficient for its determination. I have, however, some fine young living plants of the species.

I come now to the description of the El Dorado swamp, for the place is really so remarkable botanically as to be worthy of distinction under this name. It is worth, also, another effort to give some picture of the appearance of the place. The swamp (botanists will understand that the rather dismal suggestions of this word are often, as certainly in this case, undeserved) lies on a terrace midway up the mountain. Its surface is very uneven, and it is consequently much wetter in some parts than in others—its flatter parts and its hollows so saturated with wet that the foot of one who walks there sinks often up to the ankle; its higher parts islands, rarely of any great size, of dry ground scattered through the swamp. Often from these dry islands considerable groups of rocks crop out and sometimes rise to a considerable height. In the wetter parts the grass, which, of course, forms the main vegetation, is everywhere high, rank, and coarse; on the islands of drier ground the grass is finer and even turf-like; from the actual rocks grass is absent. Each of these two aspects of the swamp, wet ground and dry rocky island, presents a distinct vegetation, of which almost the only common feature is distinction from the vegetation outside this El Dorado.

Mingling and vying in height with the rank grass * of the wet parts, their flowers mingling with the blossom of the grasses, are plants of wonderful beauty. The ever lovely violet-flowered *Utricularia Humboldtii*, Schombk. [No. 43], is there, growing, not, as on the Kaieteur savannah, as an epiphyte, but with independent roots in the ground; but of this I shall have more to say presently. The *Abolboda* is there too, in a form slightly larger and much less compact than is natural to it when growing on drier ground. The flag-leaved, yellow-flowered *Xyris setigera*, Oliver [No. 62], and the small pink-flowered *Begonia tovarensis*, Klotzsch [No. 141], are also there. A very few plants of *Brocchinia cordylinoides*, Baker, just two or three single specimens, are there; but of this I shall have more to say presently. Various ferns are there, especially the magnificent Cycad-like *Lomaria Boryana*, Willd. (*L. Schomburgkii*, Klotzsch); also many orchids; a "lady's slipper" (*Selenipedium Lindleyanum*, Reichb. f. [No. 53]), with huge-branched flower-stems, each bearing many blooms, the whole plant, flower, leaf, and stem alike, all

* The grasses chiefly noticed at this place were :—*Paspalum stellatum*, Flügge; *Panicum nervosum*, Lam.; *Arundinella brasiliensis*, Raddi.

velvety in texture, and of various shades of one colour, the colour of sunlight as it falls through green young beech-leaves; the beautiful *Zygopetalum Burkeii*, Reichb. f. [No. 50]*, with flowers seeming like gigantic, pale-coloured "bee orchises" (*Ophrys apifera*, Huds.), but far sweeter in scent; in great abundance the rosy-flowered *Pogonia parviflora*, Reichb. f. [No. 115], which recalls in habit our English wild tulip (*Tulipa sylvestris*, L.); and, to mention but one more among many, *Epidendrum elongatum*, Jacq. [No. 42], its stems varying in height from one to eight feet, its verbena-like clusters of flowers varying in colour in different plants, some pale yellow, some fawn-colour, many pure rich pink, dark purple, and even mauve. This last-mentioned orchid, it may be noted in passing, is one of a group to which I shall presently refer.

The effect of the whole is as of an Alpine meadow, coloured in early summer by innumerable flowers of the brightest and most varied tints.

If this tall vegetation be anywhere parted by the hand of the curious traveller, underneath it is seen a carpet of other, low-growing, plants—*Pæpalanthus Schomburgkii* [No. 33] and *P. flavescens*, Körw. [No. 60], *Drosera communis*, A. St.-Hil.? [No. 313], a pretty little orchid, *Spiranthes bifida*, Ridley [No. 342], ferns, Lycopodiums, and sphagnum-like mosses.

One, perhaps the most remarkable, plant of the swamp has not yet been noticed. It is the South-American Pitcher-plant, *Heliamphora nutans*, Benth. [No. 258], which grows in wide-spreading, very dense tufts in the wettest places, but where the grass happens not to be long. Its red-veined pitcher-leaves, its delicate white flowers raised high on red-tinted stems, its sturdy habit of growth, make it a pretty little picture wherever it grows. But it attains its full size and best development, not down here in this swamp, but up on the ledges on the cliff of Roraima, and even on the top.

The vegetation of the drier, rocky patches is very different. A few shrubs of from four to eight feet in height, a very few stunted and gnarled trees are there, a few single specimens of the one Roraima palm (*Geonoma Appuniana*), which, as will presently be told, is much more abundant higher up; but more abundant are very dwarf shrubs of curiously Alpine aspect, such as *Gaultheria cordifolia*, H. B. K. [No. 103], and various trailing plants, such as a blackberry (*Rubus guianensis*, Focke [No. 106]), a passion-flower [No. 110], and a few orchids and ferns.

Of the orchids the most noteworthy is *Oncidium nigratum*, Lindl. [No. 114], its delicately thin, but wiry and much-branched stems, five feet high or more, seeming to float in the air a crowd of innumerable, tiny, butterfly-like flowers of cream-colour and black; but two others (*Zygopetalum Burkeii* and *Epidendrum elongatum*), which we have already seen in rank luxuriance in the wetter parts of the swamp, grow also on these drier parts, but are here much reduced in general habit, though with larger and brighter-coloured flowers. Of the ferns the most striking are a beautifully delicately cut *Schizæa* (*S. dichotoma*, Sw. [No. 100]) and a very remarkable *Gymnogramme* (*G. elaphoglossoides*, Baker, [Nos. 101 & 215]), of which more hereafter.

Again, the tiny coppices which are on the swamp and the forest which bounds it—

* This is represented on the Organ Mountains by *Z. Mackaii*, Hook.

which forest, it must be remembered, covers on the other faces of the Roraima slope what is here swamp—are full of interesting trees. One with vast numbers of large magnolia-like white flowers is *Moronobœa intermedia*, Engler [No. 337], the new species already alluded to as very closely allied to a second new species, *M. Jenmani*, Engl., which occurs in corresponding circumstances on the Kaieteur savannah. Another abundant tree represents an entirely new genus, *Crepinella gracilis*, Marchal [No. 162]; another is a new species of *Sciadophyllum* (*S. coriaceum*, March. [No. 128]). Another common, and strikingly beautiful, tree is a variety of *Byrsonima crassifolia*, H. B. K. [No. 130], with leaves the under surfaces of which are tinted with so deep and rich a violet as to impart a very striking violet shade to the whole tree, even when it is seen from a distance. Under the shade of these and the hosts of other trees ground-shrubs and tree-trunks alike are swathed in thick green mosses. There, too, but half clinging to the tree-trunks, are various species of *Psammisia* [Nos. 56 & 49], woody-stemmed creepers, the innumerable drop-like crimson flowers of which, as they catch the tiny gleams of light striking down between the thick leaves of the forest-roof, glow with intense colour. In these shady, moss-covered, quiet places stand erect many tree-ferns [Nos. 92, 270, 87, 37] and a very beautiful new aroid (*Anthurium roraimense*, N. E. Brown [No. 264]), its huge heart-shaped leaves and large arum-like flowers of purest white carried high on a slender but stiff stem. There, too, are innumerable ferns of wonderful interest, and many, but not showy, orchids—especially of the latter family, many of those tiniest and most delicate species which, if seen under a powerful magnifying-glass, would rival the most showy and graceful of their kindred of our hothouses.

We must now pass to the forest-slope, which, as has been said, consists of three fairly distinct belts or zones, which I have called respectively, beginning from the lowest, the jungle-belt, the bush-belt, and the belt of rock and tree.

The jungle is most densely interwoven with many tall shrubs or dwarf trees, which are yet more closely knit together by vast quantities of a climbing, straggling bamboo (*Guadua* [No. 359]), of a cyperaceous plant (*Cryptangium stellatum*, Bœckl. [No. 357], with rough, knife-edged leaves and tall, weak stems, which support themselves on, and at the same time densely clothe, the shrubs among which it grows*, and of a gigantic and handsome climbing fern (*Gleichenia pubescens*, H. B. K. [No. 343]). Among the shrubs also are two palms: one, in vast quantities, very stout and erect-stemmed, and large-leaved, *Geonoma Appuniana*, Spruce [No. 382]; the other, occurring only in a few scattered examples, a *Euterpe*, probably *E. edulis*, Mart., but, if so, in a most remarkably stunted and dwarfed form. It is worth noting here that, despite the reported specific abundance, by Schomburgk and Appun, of palms about Roraima, these are literally the only two plants of that Order which I saw on the mountain. Under the shrubs forming this jungle the ground was everywhere swathed with mosses, closely intermingled with innumerable ferns, especially filmy ferns; and this mossy covering reached up over the tree-stems and branches everywhere but where the sunlight fell. Under the shade of these shrubs, in the darkness and damp, grew various

* This is also a Kaieteur plant.

high-drawn terrestrial orchids, pallid plants with inconspicuous and pale flowers (*Stenoptera viscosa*, Reichb. f. [No. 131]).

Undoubtedly the most striking feature of the vegetation of this jungle-belt was the curious abundance and variety of the Ferns. Of these, two seem to require special mention here. One is the *Gymnogramme* [No. 181] already mentioned as occurring on the rocks in the swamp; it was abundantly distributed from the swamp nearly to the top of the mountain. It will be further mentioned in connection with a closely allied species occurring on the top. The second fern to be distinguished represents a very remarkable new genus, on which Mr. Baker has dwelt at some length in his report on the plants of the expedition. The genus he has called *Endoterosora* [No. 184]; the species he has been good enough to gratify me by naming after my friend the late William Hunter Campbell, LL.D., a man who, for very many reasons, but especially for his constant endeavours to forward the scientific interests of the colony, deserved so well of the people of Guiana. It is perhaps worthy of mention that this plant so closely resembles in outward appearance a form of an entirely different genus (*Polypodium bifurcatum*, L. [No. 184 ex parte]), that I collected and dried it in mistake for that plant. Were it possible to conceive that this resemblance could be of any benefit to the genus *Endoterosora*, it might be supposed that its very close resemblance to *Polypodium bifurcatum* was an instance of 'mimicry.'

Above the jungle-belt comes the bush-belt. Here the shrubs, much fewer in number and so scattered over the ground as to leave wide intervening spaces, appeared to me generally of much the same species as in the lower belt. Here, however, as is not the case below, they are sufficiently distributed to be individually distinguishable. Among them the most prominent are a great number of species of *Psychotria* [Nos. 83, 145, 185, 232], and a very remarkable yellow-flowered *Melasma*, *M.* ? *spathaceum*, Oliver, n. sp. [No. 210], of which Professor Oliver writes that the specimens supplied him are too imperfect to afford means of final determination whether this should not be regarded as the type of a new genus distinct from *Melasma*; and, in great abundance, a *Croton* (*C. surinamensi*, Muell. Arg., aff. [No. 235]). Here, too, as below, but as is not the case in the jungle-belt, occur a large number of plants of *Brocchinia cordylinoides*, still in its small Roraima, not in its larger Kaieteur form, as well as great quantities of the huge *Stegolepis guianensis*, Klotzsch. [No. 338], the *Iris*-like plants of which, being provided with a great abundance of slimy matter, made walking most difficult, in parts where they grew densely. The *Brocchinia*, too, grew in parts so densely that we had to walk, not on the ground, but on the crowns of the plants, which, as we crushed them with our feet, poured from the axils of their leaves the remarkably abundant water which they retain; and very cold water it was, over our already too cold feet. Nor must I omit to mention, though I propose afterward to sum up my observations on the *Brocchinia* and on the various species of *Utricularia*, that in this bush-belt a very few plants (I saw not more than three or four) of *Utricularia Humboldtii*, Schombk. [No. 43], of the dark Roraima form, were growing in the axils of the *Brocchinia*-leaves, as at the Kaieteur.

Two other very interesting plants appeared to us first in this bush-belt, though we afterwards found that they extended almost, if not quite, up to the top of the mountain. One, *Lisianthus*, *L. macrantho* aff. [No. 188], was a large succulent-leaved herb, almost shrub-like, with very large rich purple-crimson flowers centred with white, which would probably be a most valuable and gorgeous addition to our cultivated stove-plants. The other was the most delicately beautiful, the most fairy-like, and at the same time, for its size, the most showy plant I ever saw. It was a new *Utricularia*, which Professor Oliver, at my request, has kindly named also after William Hunter Campbell; *U. Campbelliana*, Oliv., n. sp. [No. 187], grew among the very dwarfest mosses clinging to the tree-trunks and boughs. The plant, that is the root and leaves, is so tiny that it was almost impossible to detect it when not in flower. The erect stem, an inch or more high, is hair-like; and on this is borne one (sometimes two) large and brilliant red flower, somewhat of the colour and size of the flowers of *Sophronitis grandiflora*.

One more feature of the bush-belt claims notice; the tree-ferns, occurring, indeed, in the lower jungle-belt, but there crushed out of all form and lost in the too densely packed struggle of plants, are here, in the greater and freer space, able to develop their true form and beauty, and so rise with stout erect stems to bear far overhead their regularly shaped majestic crowns of thickly growing fronds.

Next, of the rock and tree-belt all that need be said is that the same species as in the lower belt seem to occur, but that these are here, for some rather obscure reason, represented by larger and more developed individuals; that the Ferns, both the Tree-ferns and the more dwarf species, and one of the Palms, *Geonoma* [No. 382], become yet more abundant; and that the mossy universal covering which I have already dwelt on as occurring below, here becomes so immensely dense and all-pervading (the Mosses are so deep on rock and ground, and hang in such dense, long masses from all trees and branches) as to produce on the mind of one who penetrates into this remarkable spot, a wonderful and extraordinary effect of perfect and entire stillness, as though, everything being wrapped in so dense and so soft a covering, all sound and all possibility of sound were stilled, deadened, and annihilated.

Just where the rock and tree-belt meet the base of the cliff is a very narrow strip of quite distinct vegetation, so distinct, indeed, that we might almost regard it as a distinct belt, which we might call the bramble-belt. The ground there is covered by a dense thicket of bramble-bushes (*Rubus guianensis*, Focke [No. 106]), in general appearance altogether like English blackberry-bushes. Among this were large masses of the South-American form, appearing very similar to the English form, of the common Bracken, *Pteris aquilina*, L. There, too, were many little bushes of *Marcetia taxifolia*, very strongly suggestive of English heath, and there, also, was a flowering Laurustinus (*Viburnum glabratum*, H. B. K. [No. 220]), curiously like the familiar plant of our gardens. To me, after my long stay in the tropics, the whole scene suddenly seemed very homelike and pleasant. But the next minute, as I turned in another direction, the illusion was dispelled by the sight of great thickets of palms (*Geonoma Appuniana*) and a few singly standing and very stately tree-ferns.

Up from the bramble-belt, passing obliquely up the cliff face, ran the ledge by which we ascended to the top of Roraima. The lower part of the ledge, for perhaps two thirds of its length, is wide, much broken, and very uneven. This part is somewhat irregularly bush-covered. Then the continuity of the ledge is suddenly almost broken by a deep ravine, a part of the rock having been worn away by a stream which falls on to it from the cliff above. The ravine thus made is almost bare of vegetation. Above, the ledge slopes somewhat steeply, but evenly, from the point where it commences again to the top, and this part of it is covered by a dwarf vegetation never more than two or three feet high.

The shrubs on the part of the ledge below the ravine seem to be generally much the same as on the forest slope; but among these a few new ones appear. Among the latter were the very beautiful *Drimys granatensis*, Mutis [No. 242], with its very beautiful white flowers, like pendent wood-anemones, a new and beautiful *Microlicia* (*Microlicia bryanthoides*, Oliver, n. sp. [No. 239]), and several more species of *Psychotria* [Nos. 191, 291]. There, too, was an abundance of the *Lisianthus* [No. 188] already mentioned, and of *Utricularia Campbelliana*.

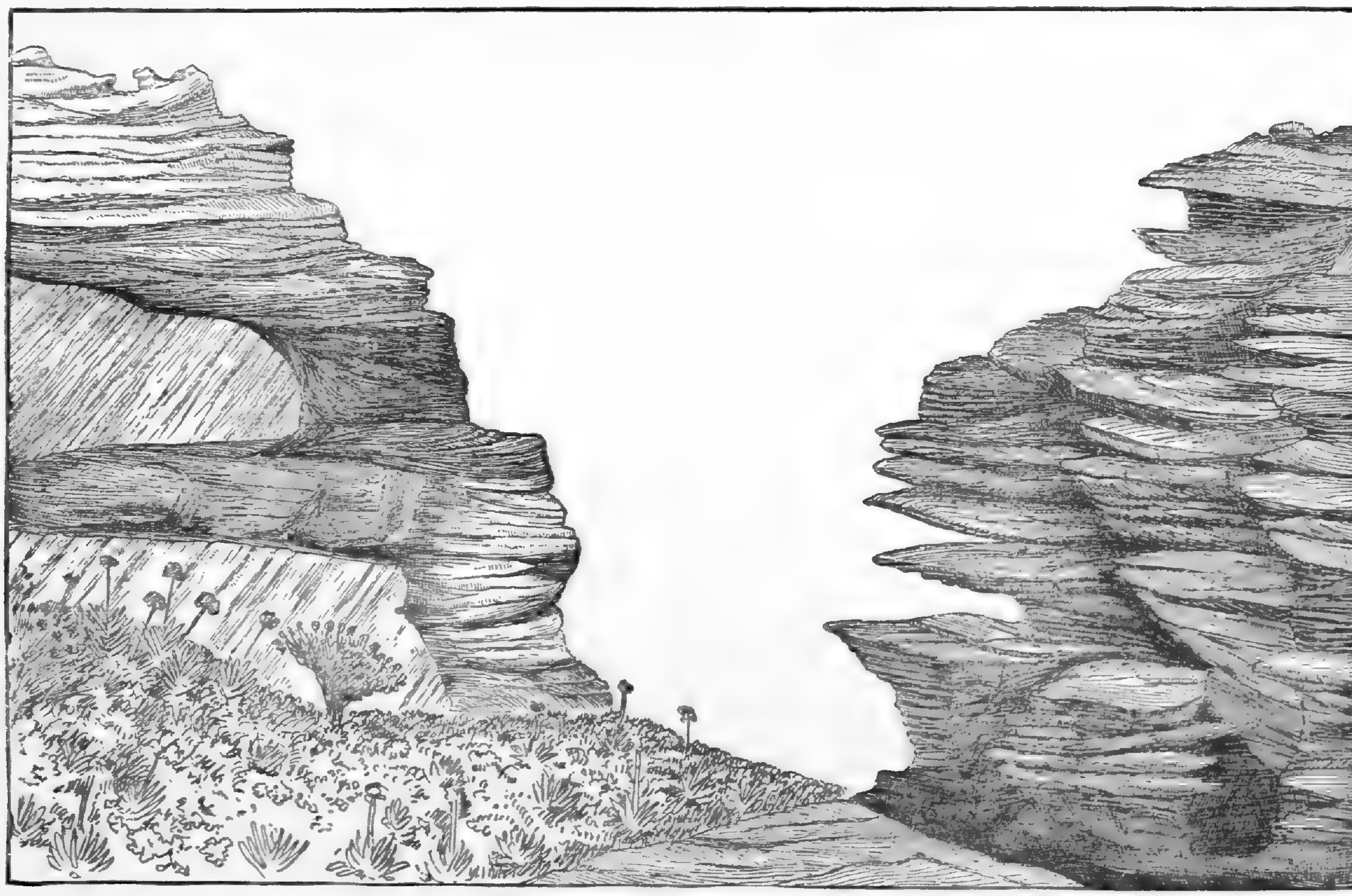
At the bottom of the ravine into which the stream falls the rocks are bare but for a large number of a pretty white-flowered *Myrtus* (*M. stenophylla*, Oliv., n. sp. [No. 324]), which, met with nowhere else, was growing abundantly in the spray of the falling water.

Beyond this ravine, on the upper part of the ledge, the true botanical paradise began. The main vegetation is formed of *Brocchinia cordylinoides*, Baker (in the axils of the leaves of which grows *Utricularia Humboldtii*), *Abolboda Sceptrum*, Oliv., and *Stegolepis guianensis*, Klotzsch [No. 338]. Among these were a great many plants entirely new to me and of most striking beauty. Many of these were shrubby, but of so diminutive a character as to be strictly alpine. Of these, by far the most beautiful was a wonderful heath-like plant, with dark green-leaved stems, stout and sturdy, but yet seeming almost overweighted by their great load of intensely vivid crimson star-like flowers. This plant [No. 308] Professor Oliver has identified as a *Ledothamnus*, possibly a variety of *L. guianensis*, Meissner, but of much more slender form than is attributed to that plant in Martius's Fl. Brasil. vii. 172.

Another shrublet, in character recalling the "Alpine rose" (*Rhododendron ferrugineum*), bore even more disproportionately large flowers, of an exquisite pink colour. It was a *Befaria*, approaching *B. resinosa*, Mutis [No. 310]. Other tiny shrubs were a white, feather-flowered *Weinmannia* (*W. glabra*, L. fil., var. [No. 244]), a myrtle (*M.* n. sp. aff. *myricoidi*, H. B. K. [No. 189]), yet another species of *Psychotria* (*P. imThurniana*, Oliver, n. sp. [No. 163]), a *Baccharis* (*B. Vitis-Idæa*, Oliver, n. sp. [No. 241]), and a *Vaccinium* (*V. floribundum*? H. B. K. [No. 329]). On most of these tiny shrubs was growing an appropriately tiny Misseltoe, *Phoradendron Roraimæ*, Oliver, n. sp. [No. 323], a miniature of an English plant. Among all these, many other interesting plants occurred. There grew, in far greater luxuriance and size than below, the pitcher-plant, *Heliamphora nutans*, Benth. [No. 258]; also great masses of two species of *Xyris*, *X. Fontanesiana*, Kunth [No. 257], and *X. witsenioides*, Oliv., n. sp. [No. 240], the latter very striking and curious by reason of the *Witsenia*-like habit of their dark green-leaved stems, with pretty star-like yellow flowers. Lastly, I found a plant with a flower which, because of its form and colour, I at first sight mistook for a fritillary, like our "Snake's-head" (*F. meleagris*); but it was a new *Lisianthus*, which Professor Oliver has named *L. imThurnianus*, Oliv., n. sp. [No. 306]. There grew many small but pretty and bright-coloured orchids—two new species of *Epidendrum* (*E. montigenum*, Ridley, n. sp. [No. 322], and another [No. 304]); also a plant of a new genus of Cryptangieæ named by Mr. Ridley *Everardia* (*E. montana*, Ridley [No. 335]).

So the vegetation of the ledge continued to the top, and indeed actually extended over the top (woodcut, fig. 3).

Fig. 3.



View at the point of entrance of the plateau on the top of Roraima.

The general effect of the vegetation of Roraima, fitly rivalling in this respect the marvellously strange geological aspect of the place, is so strange as to be very difficult of precise description. It occupies more or less wide tracts, generally almost level, between the bare flat rocks and the groups of piled rocks which occupy the greater part of the plateau. In such places it forms a dense carpet of vegetation, which is generally but a few inches, never more than a couple of feet, in height, except where, from its general level, rise a few scattered individuals of the one shrub of any conspicuous height, *Bonnetia Roraimæ*, Oliv., n. sp. [No. 330]—and that was never more than from 30 to 40 inches in height—or the many and very remarkable flower-stems of *Abolboda Sceptrum*, Oliv. [No. 312], which, to my great delight, at that height still bore its beautiful blooms, the appearance of which I have already described. Through this carpet of vegetation ran many small streams; and even in other places much water everywhere saturated the turf. A very few small plants also grew in the crevices of the piled rocks, which otherwise were bare of vegetation.

The chief constituents of this turf-like vegetation were vast quantities of a new species of *Pæpalanthus* (*P. Roraimæ*, Oliv., n. sp. [No. 294]), and great masses of *Sphagnum*-like mosses. In the latter grew, in such abundance as to redden the ground, the pretty little Sundew (*Drosera communis*, A. St.-H. [No. 313]). Groups of very luxuriant Pitcher-plants (*Heliamphora*) were there also. Great quantities of tiny shrubs, of alpine character, interwove their branches with each other and with the mosses; among these were *Weinmannia guianensis*, Klotzsch [No. 327], *Marcetia juniperina*, DC. [No. 319], *Psychotria concinna*, Oliv., n. sp. *Baccharis* [No. 241], *Ledothamnus* [No. 308], *Befaria* [No. 310], *Vaccinium* [Nos. 326, 329], *Pernettya* [No. 333, ex parte], and *Gaultheria* [No. 332]. The small *Epidendra*, as on the ledge, were here too, as was also the tiny Misseltoe (*Phoradendron* [No. 323]) and the Fritillary-like *Lisianthus* [No. 306].

A beautiful *Tofieldia* (*T. Schomburgkiana*, Oliv., n. sp. [No. 297]) and the somewhat similar *Nietneria corymbosa*, Kl. & Sch. [No. 298], with large yellow flowers, were conspicuous.

In the crevices of the rocks the vegetation was different. There was a very beautiful *Utricularia* (*U. montana*? Jacq. [No. 293]), larger and deeper in colour, but slightly less graceful, than *U. Campbelliana*, and there were three species of fern. One of these latter was a very stunted form of *Lindsaya striata*, Dryand. [No. 301], which, in its ordinary form, is common in many parts of Guiana. The other two were absolutely new—one a *Hymenophyllum*, which Mr. Baker has named *H. dejectum*, Baker, n. sp., [No. 318]; the other a *Gymnogramma* (*G. cyclophylla*, Baker, n. sp. [No. 295], a second species of the same group of this genus to which belongs *G. elaphoglossoides*, Baker, n. sp., [Nos. 101, 215], found on the lower slopes of Roraima. Only one other species of this very distinct group is known, and that has been found in the Amazon valley.

I have now briefly noticed the most striking plants which we met with on Roraima; but, before closing this paper, there are one or two points which I wish, finally, to set down in order.

First, as to *Brocchinia cordylinoides*, Baker; this is only known to occur on the Kaieteur savannah and on Roraima, but in the latter place apparently only above a height of 5500 feet. There is a remarkable difference of vigour in the habit of the plant at these two places respectively. After seeing a large number of individuals of the plant at both places, it is obvious that at the Kaieteur it attains a much greater size and forms a much taller stem; and, if I may judge from the comparative abundance or scarcity of flower-stalks, it seems to flower much more freely at the Kaieteur than on Roraima. A possible explanation of some of these facts seems to be that the position and the circumstances that it finds on Roraima, are beneficial to the plant; that the most important of these circumstances of its existence is an atmosphere, like that of Roraima or of the Kaieteur, so saturated with moisture as to effect the constant replenishment of the large quantity of water retained in the leaf-axils of the plant; and that the plant having found its way to the Kaieteur (which, though much below the proper level, is atmospherically so peculiarly suited for it), it has taken root there and, in its new surroundings of higher temperature, has there developed a new vigour. Lastly, as regards this plant, I cannot refrain from once more alluding to its possible, even probable, distribution in the other widely scattered distinct areas already enumerated.

Closely connected with the *Brocchinia* is *Utricularia Humboldtii*. Like the *Brocchinia*, this plant grows both at the Kaieteur and on Roraima; but at the former station it apparently *always* grows floating in the water retained in the leaf-axils of the *Brocchinia*, while on Roraima it grows abundantly with its roots in the ground, and only very rarely in close association with the *Brocchinia*. The Roraima plant is, moreover, far more beautiful, its flowers are of a far more intense colour, than is the Kaieteur plant; this latter circumstance is possibly mostly due to the greater vigour which the plant displays when its roots are in the ground. I have already alluded to the occurrence of a very similar *Utricularia* on the Organ Mountains, associated with a huge Bromeliad, just as it is at the Kaieteur with the *Brocchinia*.

Next, the two other large-flowered species of *Utricularia* from Roraima claim notice, *U. Campbelliana* has already been described. It occurs abundantly, but apparently only on the forest-slope and for some distance from this up the cliff.

The other species, *U. montana*, Jacq., aff. [No. 293], appears to occur only in crevices in the rocks on the summit. *U. montana* has been previously recorded from the West Indies, Colombia, and Peru. The two species, though somewhat alike in general character, are, at a second glance, evidently very distinct. *U. Campbelliana* is altogether a more delicate plant; its leaves are much smaller, rounder, and its stems are shorter; its bladders are disk-shaped. The other species is altogether a stouter plant, with longer-stalked strap-shaped leaves and with spindle-shaped bladders.

To one other set of plants I should here like to call attention. These are represented from among the plants collected during the Roraima expedition by two species of *Epidendrum* (*E. Schomburgkii*, Lindley [No. 13], and *E. elongatum*, Jacq. [No. 42]). These seem to me to be plants, from the dry rocky ground of the interior of the country, which correspond more or less closely with three forms, in a fresh state evidently very distinct, but of which dried herbarium specimens have all been classed under the one name of *E. imatophyllum*, and all three of which occur on trees near the coast. Of these coast-forms, the most distinct is one of constantly bifloral character, which occurs low down on trees overhanging the brackish water at the estuaries of the rivers; another, occurring on the tops of bushes slightly higher up the rivers, is, in general facies and in colour, very similar to the typical *E. Schomburgkii*; and the third, occurring in similar positions, but more sparingly, more nearly approaches in facies *E. elongatum*, but is constantly of a peculiar scarlet colour. The two last-mentioned forms, unlike any of the others, are invariably associated with ants, either because these creatures prefer to make their nests in the roots of the plants, or because the seeds of the plants find their most suitable nidus, and germinate, in the ants' nests.

[Note.—The following determinations and descriptions of new plants were expressly drawn up for publication in the 'Transactions of the Linnean Society,' a confidential copy being given to Mr. E. F. im Thurn to help him in writing the foregoing Introduction. During the delay required to prepare the accompanying Plates, Mr. im Thurn has taken the unprecedented course of printing the whole of the unrevised draft, at Demerara, in 'Timehri, the Journal of the Royal Agricultural and Commercial Society of British Guiana,' vol. v. pp. 145–223 (Dec. 1886), thus forestalling the present publication.—Sec. L. S.]

II. *List of the Species of Plants collected, and Determinations of those that are new. By* Prof. Oliver, *F.R.S., F.L.S.*

242. Drimys granatensis, Mutis. Ledge.

40. Guatteria. In the absence of fruit, may be referred to *G. Ouregou*, Dun. Arapoo R.

258. Heliamphora nutans, Benth. 5400 ft. and top.

96, 151. Sauvagesia erecta, L. forma. 5400 ft.

309. Leitgebia imThurniana, Oliv., sp. nov. (Plate XXXVII A. figs. 1–8); floribus distincte pedicellatis, coronæ squamulis oblongo-spathulatis antheris æquilongis v. longioribus.—Roraima: ledge and summit.

Caulis plus minus ramosus, pennæ corvinæ crassitie. Folia imbricata, coriacea, oblanceolata, acutiuscula, apicem versus utrinque 2–3-crenato-denticulata, glabra, oblique nervosa, $\frac{1}{3}$ poll. longa; stipulæ scariosæ, fimbriatæ. Flores ad apices ramulorum, $\frac{1}{2}$–$\frac{2}{3}$ poll. diam., pedicello $\frac{1}{3}$ poll. longo, 2–3-bracteolato, bracteolis anguste linearibus, stipulatis, stipulis lineari-subulatis longe ciliatis. Sepala lineari-lanceolata, acuta, rigidiuscula, $\frac{1}{4}$ poll. longa. Petala obovata, integra, $\frac{1}{3}$ poll. longa. Corona basi filamentis coalita, squamulis 5 obtusis, coloratis. Ovarium glabrum, in stylum attenuatum.

Allied to *L. guianensis*, Eichl., but much more slender, with the flowers distinctly pedicellate, and the coronal squamæ equal to or overtopping the anthers.

26. Polygala hygrophila, H. B. K. Arapoo R.

97. P. longicaulis, H. B. K. 5400 ft.

252. P., an P. variabilis, H. B. K. var.? 5400 ft.

79. Qualea Schomburgkiana, Warm.? By Teroota.

337. Moronobea intermedia, Engl., sp. nov.; ramulorum internodiis brevibus; foliis crassis, valde coriaceis, concoloribus, obovato-oblongis, in petiolum brevem canaliculatum angustatis, nervis lateralibus numerosis, patentibus, subtus paullum prominulis; floribus breviter pedicellatis, sepalis 5 suborbicularibus, cinerascentibus; petalis quam sepala circ. sexies longioribus; staminum phalangibus 5-andris, superne tantum leviter spiraliter tortis, petala fere æquantibus; ovario oblongo-ovoideo in stylum duplo breviorem stigmate 5-fido coronatum attenuato.

Roraima.

Omnino intermedia inter *Moronobeam ripariam* et *Moronobeam Jenmanni*, a priori non nisi foliis paullo majoribus et nervis minus prominulis, ab altera floribus duplo minoribus, ab utraque phalangibus andrœcei minus tortis diversa.—*Engler*.

72. Marcgraavia coriacea, V.?, vel umbellata, L. (imperfect). Near house, 5400 ft.

11. Bonnetia sessilis, Benth. Between Ireng and Cotinga R.

Label misplaced or missing. B. paniculata, Spreng.?

330. BONNETIA RORAIMÆ, Oliv., sp. nov. (Plate XXXVII. B. figs. 9–17); foliis coriaceis, parvis, oblanceolatis v. obovato-oblongis, obtusiusculis, apicem versus obscure denticulatis, eveniis, brevissime crassiuscule petiolatis; floribus ad apices ramulorum sessilibus bracteatis; sepalis late ellipticis, obtusis, breviter apiculatis, ciliolatis; petalis calyce longioribus cuneato-obovatis, truncatis v. leviter emarginatis; filamentis brevibus, basi in phalangibus 5 coalitis; antheris obovato-turbinatis, emarginatis; ovario in stylum crassiusculum apice 3-fidum angustato.

Summit of Roraima.

Folia conferta, imbricata, 4–7 lin. longa. Flores $\frac{1}{3}$–$\frac{1}{2}$ poll. diam.

A very distinct species, of which our material is rather imperfect.

8. MAHUREA EXISTIPULATA, Benth. Aroie Creek.
288. TERNSTRŒMIACEA ? (inadequate). Path to upper savannah.
22. SIDA LINIFOLIA, Cav. Arapoo R.
130. BYRSONIMA CRASSIFOLIA, H. B. K., var. ? Near house.
136. TETRAPTERIS ? (no fruit). Near house.

255. TETRAPTERIS RHODOPTERON, Oliv., sp. nov.; ramulis appresse sericeis; foliis petiolatis, obovato- v. oblanceolato-ellipticis, breviter apiculatis, basi cuneatis, utrinque tomentello-pubescentibus, supra glabrescentibus; racemis folio brevioribus, sericeis; bracteis brevissimis, ovatis, bracteolis medio pedicelli insertis, obovatis v. late ellipticis, bractea majoribus; calyce 10-glanduloso, sericeo; samaræ alis lateralibus a basi divaricatis, coriaceis, nervosis, glabris, rubescentibus, obtusis, integris v. interdum inæqualiter dentatis.

Roraima.

Folia $2\frac{1}{2}$–3 poll. longa, $1\frac{1}{6}$–$1\frac{1}{2}$ poll. lata: petiolus $\frac{1}{4}$–$\frac{1}{2}$ poll. longus. Bracteolæ geminatæ, $\frac{1}{10}$–$\frac{1}{8}$ poll. longæ. Samara alis longioribus $\frac{1}{2}$ poll. longis.

211. RAVENIA RUELLIOIDES, Oliv., sp. nov. (Plate XXXVIII. A. figs. 1–6); ramulis appresse pubescentibus; foliis unifoliolatis, petiolatis, ovalibus, utrinque attenuatis v. basi obtusis, apice obtusiusculis, nervo medio utrinque cum petiolo appresse pubescente; pedunculis in axillis superioribus 2-vel 1-floris; sepalis 2 exterioribus majoribus, ovatis v. oblongo-ovatis; petalis longe coalitis, tubo corollæ calyce 4–5-plo longiore, leviter curvato; lobis ovatis lanceolatisve; antheris 2 fertilibus, basi appendiculatis.

Roraima, upper slope.

Folia $1\frac{1}{4}$–$2\frac{1}{2}$ poll. longa, 5–12 lin. lata; nervis subtus obliquis, prominulis; petiolo 2–3 lin. longo. Flores 1–$1\frac{1}{4}$ poll. longi; corolla sericea. Calyx sepalis exterioribus $\frac{1}{5}$–$\frac{1}{4}$ poll. longis. Antheræ appendicibus brevibus, reflexis, obtusis, obovatis v. truncatis.

Closely simulating some Acanthacea, with its opposite, simple (unifoliolate) leaves, and long curved corolla-tube, sheathed at the base by the unequal sepals. The reflexed, somewhat fleshy appendage at the base of the perfect anthers has not, I believe, been observed in the two other described species of the genus.

15. Fruiting specimen, leafless, of a *Pœcilandra*?, and flowering specimen of *Gomphia guyanensis* (*Ouratea*, Aubl.)? Arapoo R.

75. Ilex Macoucoua, Pers. forma? 3500 ft.

107, 331. Ilex retusa, Kl. 5400 ft. and ledge.

35. Cyrilla antillana, Michx. Arapoo R.

334. Cyrilla antillana, var. brevifolia. Top.

21. Rhynchosia Schomburgkii, Benth. Arapoo R.

67. Swartzia, sp. nov. 5000 ft.

73. Dipteryx reticulata, Benth.? (type is too imperfect to be quite sure). Kookenaam R.

71. Cassia Roraimæ, Benth. Arapoo R.

39. Dimorphandra macrostachya, Benth. Arapoo valley.

106. Rubus guyanensis, Focke (ex descr.). "*R. Schomburgkii*, Klotzsch." Base of Cliff.

244, 321. Weinmannia glabra, L.f., var.? near *W. humilis*, Engl., but with longer pedicels. Ledge and top.

327. Weinmannia guianensis, Klotzsch. Top.

313. Drosera communis, A. St.-Hil. var.? Top.

324. Myrtus stenophylla, Oliv., sp. nov. (Plate XXXIX. A. figs. 1–9); ramosissima, ramulis ultimis gracilibus papilloso-scabridis, foliis patenti-recurvis anguste ovalibus v. lineari-oblongis acutiusculis basi in petiolum angustatis glabris, pedunculis folio brevioribus unifloris axillaribus recurvis apice bibracteolatis, bracteolis linearibus calycis tubo obovoideo obsolete puberulo longioribus, lobis calycis oblongo-lanceolatis obtusiusculis tubo subæqualibus petalis dimidio brevioribus, ovario 3-loculari, ovula in loculis plurima, bacca subglobosa, seminibus reniformibus.

Fall on ledge of Roraima, 7500 ft.

Folia circ. $\frac{1}{3}$ poll. longa, $\frac{2}{3}$–$\frac{3}{4}$ lin. lata; petiolus 1 lin. longus.

189. Myrtus, sp. nov., aff. *M. myricoidi*, H. B. K. Top and upper slope.

74. Myrcia (Aulomyrcia) Roraimæ, Oliv., sp. nov. (Plate XXXVIII. B. figs. 7–13); ramulis teretibus pilosulo-puberulis glabrescentibus cineraceis, foliis pallidis obovato-ellipticis v. late oblanceolatis obtusis basi cuneatis subtus in nervo obsolete pilosulo, supra demum nitentibus, paniculis pedunculatis axillaribus et subterminalibus, pedunculis pauce pilosulis folio brevioribus v. subæquilongis, floribus breviter pedicellatis, pedicellis pubescentibus calycis tubo turbinato glabro sæpius brevioribus, lobis calycinis brevibus late rotundatis.

Roraima, 3500 ft.

Folia 1–$1\frac{1}{2}$ poll. longa, $\frac{1}{2}$–$\frac{3}{4}$ poll. lata, vernatione supra parce pilosula; petiolus $1\frac{1}{2}$–2 lin. longus. Paniculæ cymosæ $1\frac{1}{2}$–2 poll. longæ.

82. Myrcia aff. *M. Kegelianæ*, Berg. 3500 ft.

68. Marcetia taxifolia, DC. (ex Tr.), an *M. cordigera*, DC.? Folia ovata basi cordata, marginibus late recurvis. 5400 ft.

174. MEISSNERIA MICROLICIOIDES, Naud., *M. cordifolia*, Benth., 5400 ft.

239. MICROLICIA BRYANTHOIDES, Oliv., sp. nov. (Plate XXXIX. B. figs. 10–18); fruticulosa ut videtur fastigiatim ramosa, glabra, ramulis ultimis foliiferis acute tetragonis internodiis folio 3–6-plo brevioribus, foliis patulis lineari- vel oblongo-ovalibus obtusiusculis brevissime petiolatis, floribus solitariis breviter pedicellatis ad apices ramulorum 5-meris, lobis calycinis ovato-lanceolatis tubo fere æquilongis persistentibus, antheris majoribus connectivo producto subæquilongis.

Roraima, ledge 6500 ft.

Folia $\frac{1}{5}$–$\frac{1}{4}$ poll. longa, $\frac{1}{15}$ poll. lata. Flores $\frac{1}{2}$–$\frac{2}{3}$ poll. diam. Capsula calyce persistente vestita $\frac{1}{8}$ poll. longa, lobis calycis (temp. fruct.) erectis deltoideo-subulatis rigidis.

59. PTEROLEPIS LASIOPHYLLA, Tr.

20. PLEROMA TIBOUCHINUM, Tr. (*Tibouchina aspera*, Aubl.). Arapoo R.

319. MARCETIA JUNIPERINA, DC. Top.

89. CENTRONIA CRASSIRAMIS, Tr. 5750 ft.

216, 305. MONOCHÆTUM BONPLANDII ?, Naud. Upper slope and top.

277. OXYMERIS aff. *O. glanduliferæ*, Tr. (Facies *Miconiæ pauperulæ*, Naud. ?) Path to upper savannah.

Closely resembles the above *Miconia*, but our specimen is not good.

256. MICONIA FOTHERGILLA, Naud. House.

223. MICONIA, sp. (inadequate). Path.

30, 70. MICONIA DECUSSATA, Don. Arapoo R.

222. MERIANIA ? aff. *M. sclerophyllæ*, Tr. (Imperfect.) Forest slope, 6000 ft.

2. CUPHEA GRACILIS, H. B. K., var. MEDIA.

4. PASSIFLORA FŒTIDA, L., var. Konkarmo.

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84. PASSIFLORA, sp., e sect. *Murucuiæ* (ut videtur). Folia petiolata, petiolis pollicaribus apice utroque latere glandula majuscula circulari præditis, laminis $4\frac{1}{2}$–5 poll. long., $2\frac{1}{2}$ poll. lat., glabris subtus glaucescentibus subcoriaceis late ovato-oblongis acutis basi rotundatis, raro arcuatim nervosis. . . . . . Pedunculi . . . . . foliis subæquilongi apice racemosi. . . . . Alabastra cylindrato-oblonga acutiuscula. Floris tubus elongatus, obconicus. Sepala petalaque, ut videtur, brevia oblonga obtusa vel rotundata. Corona faucialis e ligulis petaloideis brevibus constans . . . Gynandrophorum gracile . . . . cæt. desunt.—*M. T. Masters.*

Roraima.

110. PASSIFLORA, sp., e sect. *Astrophea* ? Fruticosa cirrosa. Folia breve petiolata, petiolis. . . . . sub $\frac{1}{2}$ poll. long., laminis $2\frac{1}{4}$ poll. long., $1\frac{1}{2}$ poll. lat., coriaceis glabris raro arcuatim venosis oblongis basi apiceque rotundatis. . . . Cirri simplices. . . . Bracteæ. . . . Alabastra oblonga obtusa. Floris tubus brevis tubulato-campanulatus basi haud intrusus. Sepala 5–6 lin. longa oblonga obtusa navicularia extus tomentosa intus maculis linearibus purpureis verrucisque albidis notatis. Petala sepalis conformia parum breviora tenuiora, membranacea, albida maculis purpureis minimis

crebris obsita. Corona faucialis biserialis, series extima e ligulis petalis æquilongis petaloideis, purpureo-maculatis, dolabriformibus, apice obliquis et in acumen longiusculum tortum prolatis, series intima e filis numerosis præcedentibus dimidio brevioribus, capitatellatis. Corona mediana e tubo versus medium assurgens basi membranacea, apice in fila brevia divisa. Corona infra mediana e tubo versus basin emergens annularis, subcarnosa margine deflexa. Tubi facies interna, inter coronas, processubus parvis membranaceis ut videtur dense obsita. . . . cæt. desunt. Gynandrophorum basi ut videtur quinquangulum, angulis anguste alatis, supra medium tumidum ibique puberulum. Antheræ oblongæ obtusæ flavidæ. Ovarium ut videtur oblongum angulatum longitudinaliter costatum puberulum. Stigmata majuscula reniformia.—*M. T. Masters.*

Roraima.

141. Begonia tovarensis, Klotzsch, var. ?; fructibus breviter alatis. House.

ARALIACEÆ. By M. E. Marchal.

Crepinella, nov. gen. Flores hermaphroditi. Calycis margo brevis obsolete 4-dentatus. Petala 4 valvata. Stamina tot quot petala, sub disco epigyno explanato superne in stylum sulcatum abeunte inserta, filamentis brevibus et antheris ovatis. Ovarium 1-loculare, 1-ovulatum, ovulo pedulo. Fructus ignotus.

Frutex (?) glaber. Folia digitata. Flores in umbellas compositas terminales digesti. Bracteæ parvæ squamiformes. Pedicelli sub flore continui.

Notwithstanding the absence of fruit, the genus *Crepinella* is very different from other Araliaceæ with 1-celled, 1-ovuled ovary, differing from *Eremopanax*, Baillon, *Cuphocarpus*, Decne. & Naud., and *Mastixia*, Blume, in its digitate leaves and umbellate tetramerous flowers.

Dedicated to Mons. Crépin, Director of the Botanic Gardens, Brussels.

162. Crepinella gracilis, March., n. sp. (Plate XL. figs. 1–6); foliis 5-natis, petiolo sulcato basi abrupte dilatato, foliolis breviter petiolulatis, ovato-ellipticis, apice obtusis vel marginatis, basi acutiusculis, margine integerrimis sive revolutis, pergamaceis, costa infra prominente, umbellulis longiuscule pedunculatis, 8–12-floris, pedunculo gracili profunde sulcato superne incrassato; floribus minutis pedicello basi bracteolato 4-plo brevioribus, calycis tubo obconico, 8-sulcato, corolla hemisphærica acutiuscula sulcata, petalis ellipticis, apice leviter incrassatis incurvis, nervia extus impressa notatis, stylo gracili latitudinem disci vix æquante, fructu. . . . .

Roraima.

Rami supremi graciles. Petiolus communis circ. 5 cm. longus. Petioluli 6–10 mill. longi. Foliola 4–5 cm. longa atque 3 cm. lata. Pedicelli 5–7 mill. longi.

128. Sciadophyllum coriaceum, March., nov. sp. (Plate XLI. figs. 1–8); inflorescentiis foliisque subtus tomento adpresso subferrugineo demum hinc inde deterso vestitis,

foliis digitatis, 5–7-natis, foliolis ellipticis, apice rotundatis v. sæpius leviter emarginatis basi acutiusculis margine integerrimis anguste revolutis crassiusculis coriaceis, supra denudatis, reticulo nervorum densiusculo infra valde prominente, floribus in umbellas duas compositas superpositasque digestis, umbellulis numerosis, 9–12-floris, pedunculo compresso elongato superne dilatato, radiis filiformibus basi bracteolatis, calycis limbo minute 5-dentato, corolla hemisphærica acutiuscula, petalis apice cohærentibus demum a basi secedentibus, staminum filamentis brevibus, stylis in unum sulcatum 5-fidum latitudinem disci epigyni vix æquantem concretis fructu. . . .

Roraima.

Allied to *Sciadophyllum japurense*, Mart. et Zucc., but differing in leaves, inflorescence, and style.

Arbor. Rami supremi 2 cm. crassi. Petiolus communis 20 cm. longus. Petioli 2–4 cm. longi. Foliola 11–13 cm. longa atque 4–5 cm. lata. Pedicelli 5–8 mill. longi.

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220. Viburnum glabratum, H. B. K. Base of cliff.
134. Coccocypselum canescens, Willd., var. House.
6. Kotchubæa (*Synisoon Schomburgkianum*, Baill.). Aroie Creek.
69. Declieuxia chiococcoides, H. B. K. House.
29. Sipanea pratensis, Aubl. Arapoo R.
135. Cephaëlis axillaris ?, Sw. House; upper slope.
83. Psychotria inundata, Benth. 3500 ft. Upper slope.
145, 232. Psychotria crassa, Benth. ? House. Upper slope.
185. Psychotria, sp. (=Schombk. 1018 B and Appun. 1103). Upper slope.

163, 320. Psychotria Imthurniana, Oliv., sp. nov. (Plate XLII. A. figs. 1–7.) Glaberrima; ramulis gracilibus internodiis rectis subteretibus, foliis subsessilibus anguste vel lineari-lanceolatis acuminatis basi obtusissimis subcordatisve, costa prominula, nervis secundariis utrinque circ. 10–15 incurvis prominulis nervum marginalem attingentibus cum venulis intermediis, stipulis basi connatis deltoideo-subulatis brevibus, cymis terminalibus pedunculatis 9–15-floris laxiusculis bracteis obsoletis, calycis limbo 4-dentato dentibus deltoideis, corollæ tubo cylindrico limbo 2-plo longiore.

Roraima, upper slope and ledge, 7000 ft.

Folia tenuiter coriacea flavescentia, $1\frac{3}{4}$–$2\frac{1}{4}$ poll. longa, $\frac{1}{2}$–$\frac{2}{3}$ poll. lata. Flores 2–$2\frac{1}{2}$ lin. longi; corollæ limbus 2–$2\frac{1}{2}$ lin. diam., lobis ovatis obtusis, tubo intus piloso. Ovarium biloculare.

191, 214. Psychotria, sp. (Imperfect.) Upper slope and path.
291. Psychotria ? sp. Path to upper savannah.

Psychotria concinna, Oliv., sp. nov. (Plate XLII. B. figs. 8–15.) Glaberrima, ramulis gracilibus atro-purpureis, foliis petiolatis parvis coriaceis ovalibus acutis v. acutiusculis, supra costa subprominula nervis lateralibus obsoletis, subtus costa prominente nervis secundariis utroque latere 7–10 prominulis patentim curvatis nervum marginalem attingentibus, stipulis liberis (utrinque geminatis) e basi crassiuscula erectis subulatis rigidiusculis, floribus in cymis paucifloris parvis breviter pedunculatis terminalibus dispositis, pedicellis brevissimis, calycis lobis minutis ovatis, corollæ tubo recto gracili glabro intus medium versus pilosulo superne leviter dilatato, lobis brevibus ovatis.

Roraima, ledge 6500 ft. and summit.

Folia 7–12 lin. longa, $\frac{1}{4}$–$\frac{1}{3}$ poll. lata; petiolus 1–1$\frac{1}{2}$ lin. longus. Cymæ 5–8-floræ. Corolla 6–7 lin. longa (lobi 1 lin.).

66. Palicourea riparia ?, Benth., forma angustifolia.
85. Palicourea rigida, Kunth.
90. Relbunium (=Schombk. 646, 984 β). 5400 ft.
23. Eupatorium amygdalinum, DC. Arapoo R.
No label. Eupatorium, sp. ? (not identified).
95. Eupatorium conyzoides, Vahl, var. 5400 ft.
91. Mikania pannosa, Baker. 5400 ft.
16. Pectis elongata, H. B. K. Wai-ireng R.

241, 325. Baccharis Vitis-Idæa, Oliv., sp. nov. (Plate XLIII. A. figs. 1–8); ramulis ultimis puberulis, foliis crebris tenuiter coriaceis oblanceolatis obtusis apice 1–3–5-mucronatis in petiolum basi cuneatim angustatis glabris, capitulis campanulato-hemisphæricis 15–20-floris in corymbis terminalibus sæpius sessilibus dispositis, involucri bracteis pauciseriatis, interioribus (in cap. ♀) scariosis anguste lineari-oblongis deciduis, pappo albido.

Roraima, ledge 7300 ft. and summit.

Folia $\frac{1}{2}$–1 poll. longa, 3–4$\frac{1}{2}$ lin. lata. Capitula $\frac{1}{5}$–$\frac{1}{4}$ poll. diam.; bracteis exterioribus ovatis v. ovato-lanceolatis plus minus scariosis margine apicem versus sæpe denticulatis v. minute fimbriatis (in invol. ♂ ut videtur obtusioribus). Achænia lineam longa angulata glabrata; pappus achænio longior, setis circ. 30 minute barbellatis.

Resembles some forms of *B. ligustrina*, DC.

328. Baccharis aff. *B. cassiniæfoliæ*, DC., an var. ?
63. Achyrocline flaccida, DC. 4000 ft.
250. Gnaphalium spicatum, Lam. 5400 ft.
86. Verbesina guianensis, Baker. 5400 ft.

27. Calea ternifolia, Oliv., sp. nov. (Plate XLIII. B. figs. 9–16.) Suffrutex scaber, foliis ternatis ellipticis v. ovato- v. obovato-lanceolatis breviter petiolatis late acutatis utrinque apicem versus 1–3-dentatis supra scabris subtus præcipue in costa nervisque setulosis, capitulis circ. 30-floris homogamis pedunculatis ad apices ramulorum umbellatim dispositis, involucri squamis exterioribus herbaceis ovatis v. ovato-oblongis capitula brevioribus, squamis interioribus rigidiusculis late oblongis obtusis striatis, paleis concavis obtusis superne leviter dilatatis, ovariis parce setulosis paleis pappi acuminato-subulatis brevioribus.

Arapoo River.

Folia rigida $\frac{3}{4}$–$1\frac{1}{3}$ poll. longa, 5–8 lin. lata; petiolus ad 1 lin. longus. Umbellæ 3–5-cephalæ, pedunculis hispidulis capitulis sæpe paullo longioribus. Capitula late campanulata $\frac{1}{3}$ poll. longa atque lata.

247. Erechthites hieraciifolia, Raf. 5400 ft.
10. Stifftia condensata, Baker. Near Waetipoo M.
314, 346. Centropogon lævigatus, A. DC., var.? Ledge 5400 ft.
77. C. surinamensis, Presl? 3500 ft.
56. Psammisia? sp. (inadequate). 5400 ft.

49. Psammisia, with glabrous smooth purple-brown stem, ovate-oblong, shortly apiculate quintuplinerved leaves of 4 to 6 in., and contracted umbelliform racemes of flowers 1 in. in length on pedicels of $\frac{1}{2}$–$\frac{3}{4}$ in. This is probably Schomburgk's nos. 670, 974, of which corollas are wanting in our example. Whether it be Klotzsch's *P. guyanensis* I cannot say.

Roraima, upper slope.

Under the same no. is apparently another *Psammisia* in early bud, with more broadly elliptical leaves and acute calyx-segments.

109. Notopora Schomburgkii, Hook. f. 5400 ft.
243. Sophoclesia aff. *S. subscandenti* (ovario glabro). Ledge 7300 ft.
329. (333?). Vaccinium, an *V. floribundum*, H. B. K.? (*V. polystachyum*, Benth.). Top and ledge.
326 365. Vaccinium, an *V. floribundum*, H. B. K., var.? Top.

308. Ledothamnus guyanensis, Meissner in Mart. Fl. Bras. vii. 172. (Plate XLIV. A. figs. 1–6.) 172. Var. minor; foliis minoribus imbricatis acutis ciliolatis, floribus sessilibus v. subsessilibus, filamentis anthera 3–5-plo longioribus.

Roraima, upper part of ledge and summit.

Possibly a distinct species, but, as our Schomburgk specimens are more advanced and scarcely in a comparable state, it is better left as above for the present. The leaves are only about $2\frac{1}{2}$ lines long (in the type 4 lines), minutely setulose-ciliolate. Flowers 1 to $1\frac{1}{4}$ in. in diameter, of vivid crimson. In our type the flowers are on pedicels, of $\frac{1}{4}$ to 1 in., but these may perhaps elongate after flowering.

Label missing. Befaria guianensis, Klotzsch.
310. Befaria aff. *B. resinosæ*, Mutis (sepalis obtusioribus). (2 forms.) Top.
With no. 333. Pernettya, near *P. parvifolia*, Benth., and allies (in fruit).
103. Gaultheria cordifolia, H. B. K. 5400 ft.
332. Gaultheria aff. *G. vestitæ*, Benth. (pedicellis longioribus). Top.
137. Lucuma rigida, Mart. & Eichl. 5400 ft.
108. Grammadenia lineata, Benth. 5400 ft.
36. Ditassa taxifolia, Decne. Arapoo R.

155. Vincetoxicum (Orthosia) hirtellum, Oliv., sp. nov.; volubile, caule gracili pilis brevibus subpatentibus hirto, foliis ovali-oblongis rigidiuscule apiculatis, marginibus revolutis, supra hirtellis in sicco rugulosis, subtus præcipue in costa pilis patentibus hirtis, cymis sessilibus v. brevissime pedunculatis pauci- v. pluri-floris foliis brevioribus, floribus subsessilibus v. pedicello calyce vix longiore, corollæ lobis angustis intus hirsutis, coronæ segmentis 5 basi in annulo brevissimo continuo insertis lineari-lanceolatis gynostegium fere æquantibus, stigmate obtuso.

Roraima.

Folia $\frac{2}{3}$–$\frac{3}{4}$ poll. longa; petiolus $\frac{1}{12}$ poll. longus v. brevior. Flores $\frac{1}{8}$ poll. longi

Very much resembles in general facies *Ditassa pauciflora.*

147. Nephradenia linearis, Benth.?

113. Curtia (*Schuebleria tenuifolia,* Don). 5400 ft.

47. Lisianthus amœnus, Miq. 5400 ft.

306. Lisianthus Imthurnianus, Oliv., sp. nov. Gracilis, glaberrimus, caule inferne folioso teretiusculo internodiis folio brevioribus utrinque lineis elevatis duabus notatis, foliis coriaceis obovatis ellipticisve obtusis v. obtusiusculis margine anguste revolutis triplinerviis, pedunculo elongato cymis 3–2-floris, floribus longe pedunculatis, calyce ($\frac{1}{4}$–$\frac{1}{3}$ poll. longo) 5-fido, lobis ovato-lanceolatis acutiusculis, corollæ (2-poll.) tubo leviter dilatato, limbi lobis oblongo-ovatis acutis, filamentis elongatis gracilibus glabris inclusis, antheris oblongo-ellipsoideis inappendiculatis.

Roraima, ledge and summit.

Caulis 1-pedalis erectus v. basi decumbens. Folia $\frac{2}{3}$–$\frac{3}{4}$ poll. longa, basi in petiolum angustata, $\frac{1}{3}$–$\frac{1}{2}$ poll. lata. Pedunculus communis 3–6 poll. longus; bracteæ superiores lineares v. ovales. Discus hypogynus.

In our specimens the limb of the corolla looks as though it might remain straight or even slightly incurved in flower.

188. Lisianthus aff. *L. macrantho,* sed calycis lobis acuminatis corollæ tubum æquantibus. Upper slope.

3. Heliotropium aff. *H. fruticoso,* conf. *H. strictissimum*=Schombk. 185, 283, and 573. Konkarmo.

24. Solanum, an *S. Convolvulus,* Sendtn.? (inadequate). Arapoo R.

210. Melasma? spathaceum, Oliv., sp. nov.; scabrum, foliis suboppositis v. inferioribus alternis brevissime petiolatis ovato-ellipticis basi rotundatis v. leviter cordatis dentatis supra scabris, floribus pedunculatis in axillis superioribus pedunculis folio subæquilongis apice bibracteolatis, bracteolis linearibus v. oblanceolatis basi angustatis, calyce alabastro acuminato florifero antice fisso spathaceo, corolla exserta leviter incurva tubo superne leviter dilatato, limbi brevis lobis subæqualibus, lobo postico truncato emarginato, lateralibus obtusissimis, antico obovato-rotundato bifido.

Roraima, upper slope.

Ramuli retrorsum hispiduli. Folia (exsicc. nigrescentia) $\frac{3}{4}$–$1\frac{1}{4}$ poll. longa, 4–7 lin. lata. Calyx 5-nervius, alabastro oblongo-ellipsoideus apice acuminatus, parce, præcipue in nervis, scabridus, 10–12 lin. longus. Corolla $1\frac{1}{4}$ poll. longa. Stamina inclusa didynama; filamenta glabra; antheræ sagittatæ glabræ dorsifixæ, loculis æqualibus basi apiculatis. Ovarium glabrum.

I have had too imperfect material to determine finally if this plant should be left in *Melasma*, or regarded as the type of a new genus. There are no ripe fruits, and I should like to be more confident about the form of the corolla-lobes and their æstivation.

129. Beyrichia ocymoides, Cham. Circ. 5400 ft.
43. Utricularia Humboldtii, Schombk. 5400 ft.

187. Utricularia (§ Orchidioides) Campbellianum, Oliv., sp. nov. (Plate XLIV. B. figs. 7–11); scapo gracili ($1\frac{1}{2}$–$2\frac{1}{2}$-pollicari) unifloro sæpius squamis linearibus v. lineari-lanceolatis remotis bracteiformibus instructo, foliis tenuibus obovatis obtusis basi in petiolum angustatis, bracteis ternis ovatis v. oblongo-ellipticis pedicello brevioribus v. æquilongis, calycis lobis ovato-cordatis obtusis, corollæ labio superiore brevi calycem vix superante, labio inferiore amplo rotundato integro, calcari gracili cylindrico acutato incurvo labium corollæ æquante.

Roraima (*Schomburgk*), upper slope.

Folia cum petiolo $\frac{1}{2}$ poll. longa, lamina $\frac{1}{6}$–$\frac{1}{4}$ poll. lata. Calyx lobis 4–5 lin. longis latisque. Corolla labio inferiore 1 poll. lato.

293. Utricularia aff. *U. montanæ*, Jacq. (*U. uniflora*, Ruiz & Pav.). Top.
78. Utricularia, an *tenuifolia*, Benj.? 3500 ft.
287. Gesneracea? In fruit only. Path to upper savannah.

64. Tabebuia Roraimæ, Oliv., sp. nov. (Plate XLV. figs. 1, 2); ramulis ultimis puberulo- vel scabrido-lepidotis, foliis trifoliolatis foliolis oblongo-ellipticis obtusis sæpe mucronulatis, lateralibus breviter petiolulatis, supra glabrata subtus cano-lepidotis nervis conspicuis depresso-areolatis, racemis terminalibus pauci- v. plurifloris, bracteis lineari-spathulatis scaberulis, pedicellis erectis bibracteolatis calyce infundibuliformi lepidoto-puberulo, lobis breviter ovato-rotundatis, corollæ tubo calyce triplo longiore infundibuliformi, limbi lobis patulis late rotundatis.

Roraima, 5000 ft.

Folia petiolata; petiolus (in ramulis floriferis) 1–$1\frac{1}{2}$ poll. longus; foliola 2–$3\frac{1}{4}$ poll. longa, 10–16 lin. lata; petiolulus centr. $\frac{1}{4}$–$\frac{1}{2}$ poll. longus. Flores $3\frac{1}{2}$–4 poll. longi, limbo $2\frac{1}{2}$–3 poll. lato.

14. Aphelandra pulcherrima?, Kunth, v. A. tetragona, Nees. Ireng R.
81. Justicia, sp.,=Appun, 1387 (in part.). Kookenaam valley.
52. Lippia Schomburgkiana, Schau.
1. Stachytarpheta mutabilis, Vahl. Konkarmo.
38. Hyptis arborea, Benth. Arapoo R.

98, 249. HYPTIS LANTANÆFOLIA, Poit. 5400 ft.
111. COCCOLOBA SCHOMBURGKII, Meiss. 5400 ft.
139. PEPEROMIA, not identified; material scarcely adequate. 5400 ft.
140, 196. PEPEROMIA, an *P. tenella*, Dietr.? 5400 ft., and upper slope.
224. PEPEROMIA REFLEXA, Dietr. Upper slope.
219, 236. HEDYOSMUM BRASILIENSE, Mart.? Upper slope.

323. PHORADENDRON RORAIMÆ, Oliv., sp. nov. Flavescens, ramulis teretibus infra nodos interdum compressis crassitie pennæ corvinæ parce hirtellis, foliis lineari-oblongis v. anguste ovalibus acutiusculis, floribus monoicis, spicis 1-articulatis 5–7-floris, baccis ellipsoideis lævibus? carnosis.

Roraima, ledge and summit.

Folia carnosula moderate coriacea parce pilosula v. glabrata basi in petiolum brevem angustata, 5-9 lin. longa, 1–2 lin. lata; internodia $\frac{1}{2}$–1 poll. longa. Spicæ axillares solitariæ apiculatæ 1–2 lin. longæ; vagina bracteali leviter bidentata v. subtruncata lateraliter compressa.

Mr. im Thurn's no. 276 (Roraima, path to upper savannah) may be a glabrate form of this plant with rather broader obtuse obscurely mucronulate leaves.

142. PHYLLANTHUS PYCNOPHYLLUS, Muell. Arg. Circ. 5400 ft.
235. CROTON, aff. *C. surinamensi*, Muell. Arg. Forest belt.
76. SPONIA MICRANTHA, Sw. 3500 ft.
58. BURMANNIA BICOLOR, Mart. 4000 ft.
121. DICTYOSTEGIA OROBANCHOIDES, Miers. Upper slope.

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280. PLEUROTHALLIS STENOPETALA, Lindl. Upper slope, Roraima.
183. STELIS GRANDIFLORA, Lindl. Upper slope, Roraima.
285. STELIS TRISTYLA, Lindl. Upper slope, Roraima.
127. LEPANTHES (inadequate). 5400 ft. (our house).
275. OCTOMERIA? sp. Upper slope.
289. MICROSTYLIS UMBELLULATA?, Sw.
279. MASDEVALLIA PICTURATA, Reichb. f. Upper slope.
286. MASDEVALLIA BREVIS, Reichb. f. Upper slope.
57. BULBOPHYLLUM GERAENSE, Reichb. f. (Our house, 5400 ft.)
290. ELLEANTHUS FURFURACEUS, Reichb. f. Upper slope.
274. EPIDENDRUM TIGRINUM, Lindl. Upper slope.
13. EPIDENDRUM SCHOMBURGKII, Lindl. Treng River.
42. EPIDENDRUM ELONGATUM, Jacq. (Our house, 5400 ft.)

296. EPIDENDRUM ALSUM, Ridley, n. sp. (§ Euepidendra planifolia paniculata.) Caulis

validus, $\frac{1}{4}$ unciam crassus, ramosa. Folia coriacea brevia ovata obtusa, $1\frac{1}{4}$ ad $\frac{3}{4}$ unciam longa, $\frac{3}{4}$ lata, vaginis rugosis vix uncialibus. Panicula abrupte deflexa, ramis duobus flexuosis 1 ad $2\frac{1}{2}$ uncias longis. Flores parvi carnosi, 8 in ramo, dissiti. Bracteæ ovatæ cucullatæ subobtusæ. Sepala lanceolata carinata. Petala angusta lanceolata quam sepala dimidio breviora, et paullo tenuiora. Labellum cymbiforme, ovatum, cordatum, carnosum. Columna brevis.

Top of Roraima. The affinity of this plant is with *E. frigidum*, Linden.

299. Epidendrum Imthurnii, Ridley, n. sp. (Plate XLVI. A. figs. 1–6.) Caulis gracilis teres parum ramosus ultra 7-uncialis. Folia angusta lineari-lanceolata coriacea carinata, unciam longa, $\frac{1}{8}$ unciam lata, vaginis rugosis. Racemi 2 vel 3, deflexi, vix unciales, sex-flori. Flores parvi, tenues. Bracteæ ovatæ, pedicelli $\frac{2}{3}$ æquantes. Pedicelli $\frac{1}{8}$-unciales. Sepala lanceolata oblonga obtusa curva, circiter $\frac{1}{8}$ unciam longa. Petala linearia angusta uninervia. Labellum ovatum cordatum cymbiforme, basi angustatum. Columna gracilis paullo recurva. Anthera pileata subconica obtusa. Capsula fusiformis.

Top of Roraima.

322. Epidendrum montigena, Ridley, n. sp. Caulis teres gracilis, ultra semipedalis. Folia elliptica lanceolata mucronata carinata, unciam longa, $\frac{3}{8}$ lata, vaginis $\frac{3}{4}$-uncialibus rugosis. Racemi deflexi multiflori, haud ramosi, circiter 3 uncias longi. Flores parvi, tenues. Bracteæ ovatæ subacutæ patentes. Sepala lanceolata, ovata falcata, $\frac{1}{4}$ unciam longa. Petala angustiora lanceolata. Labellum cymbiforme, late cordatum, carnosum.

Ledge and top.

51. Epidendrum durum, Lindl. Our house.

360. Epidendrum violascens, Ridley, n. sp. (Plate XLVI. B. figs. 7–10.) Caulis semipedalis gracilis foliis distichis tectus. Folia brevia lanceolata crassiuscula recurva, $\frac{1}{4}$ unciam longa, vaginis superiorum violaceis. Panicula erecta gracilis 5-uncialis, ramis paucis tenuibus. Flores pauci perparvi. Bracteæ lanceolatæ breves recurvæ. Sepalum posticum lanceolatum obtusum trinerve, lateralia basi connata, et ad basin labello adnata, lanceolata obliqua, apicibus excurvis, trinervia. Petala linearia angusta uninervia. Labellum rotundatum subreniforme, marginibus serrulatis; costæ tres elevatæ, versus apices attenuatæ. Columna crassiuscula.

Top of Roraima.

304. Epidendrum, sp. Ledge, 7500 ft.

80. Cattleya Lawrenceana, Reichb. f. From the locality given, I believe this to be *C. pumila*, Schomb., Reise Brit. Guian. p. 1068 (non Hooker). There is a picture of it among Schomburgk's drawings preserved in the British Museum.

Roraima.

55. Cyrtopodium parviflorum, Lindl. Roraima, 4000 ft.

61. Koellensteinia Kellneriana, Reichb. f. Roraima, 4000 ft.

50. Zygopetalum Burkei, Reichb. f. Our house.

360. ZYGOPETALUM VENUSTUM, Ridley, n. sp. (Plate XLVII. figs. 1–6.) Planta cæspitosa, pseudobulbis nullis. Folia bina, evoluta, lanceolata acuta, basi attenuata, subcoriacea, costis tribus elevatis in dorso, 7 ad 8 uncias longa, $\frac{5}{8}$ lata. Scapus lateralis erectus, 13 uncias longus, vaginis 2–3, apicibus obtusis, amplexis, paullo ampliatis remotis. Racemus laxus, 10-florus. Flores mediocres, unciam longi et lati. Bracteæ pedicellis multo breviores, cylindricæ, ovatæ, acutæ, inferiores vaginantes. Pedicelli $\frac{1}{2}$ unciam longi. Sepala ovata, lanceolata, subacuta patula. Petala subsimilia, obtusiora et angustiora. Labellum integrum, mentum plicatum, lamina rhomboidea, obtusa, lata. Columna brevis crassiuscula, alis magnis obtusis falcatulis, apicibus curvis. Anthera subconica. Stigma semilunare.

Kookenaam River, 3000 ft.

There is a figure of what seems to be the same species in the drawings made by Schomburgk, preserved in the British Museum. It was obtained at Takootoo, and is represented as having white flowers, with the base of the lip and the mentum yellow and a few faint purple stains towards the apex of the lip, and purple streaks on the face of the column. The fruit is deflexed, oblong in shape. In the absence of a distinct pseudobulb, this plant differs from the rest of the genus, but the flowers are exactly those of *Zygopetalum*.

114. ONCIDIUM NIGRATUM, Lindl. 5400 ft. (our house).

12. ONCIDIUM ORTHOSTATES, Ridley, n. sp. (Plurituberculata Homæantha expansa.) Pseudobulbus oblongus, 2 uncias longus. Folium lanceolatum oblongum, 3 uncias longum, 1 unciam latum. Scapus elatus validulus rigidus ultra bipedalis. Bracteæ lanceolatæ deflexæ breves $\frac{1}{8}$-unciales. Flores mediocres, iis *O. cæsii* æquantes. Pedicelli $\frac{1}{2}$ unciam longi. Sepala lanceolata subacuta. Petala subsimilia viridia brunneo maculata (ex sicco). Labelli lobi laterales spathulati obtusi, medius basi angustatus rotundatus reniformis emarginatus, cuspide minuto. Callus, carina lamellas duas breves gerens. Columna brevis stelidiis obtusis magnis dolabriformibus tenuibus. Pedicellus polliniorum elongatus ligulatus, discus oblongus quadratus, margine exteriore eroso.

Treng River; also 23, Savannah, *W. H. Campbell* in Herb. Kew.

19. SOBRALIA STENOPHYLLA, Lindl. Spelinioola, Arapoo River.

273. SOBRALIA (inadequate). Upper slope, Roraima.

115. POGONIA PARVIFLORA, Reichb. f. 5400 ft. (our house).

342. SPIRANTHES BIFIDA, Ridley, n. sp. Tubera elongata clavata. Folia ovata petiolata acuta tenuia parva, lamina semiunciam longa, $\frac{1}{4}$ unciam lata, petiolus vix semiuncialis. Caulis debilis parce pubescens, ferme 10-uncialis; vaginis circiter 9, laxis lanceolatis acuminatis dissitis $\frac{1}{3}$ unciam longis. Racemus densus spiralis, unciam longus. Bracteæ flores superantes, lanceolatæ acuminatæ. Sepala, petala et labellum subsimilia, lanceolata angusta obtusa, marginibus involutis, apicibus bifidis, minute

papillosa. Petala quam sepala angustiora. Columna brevis. Anthera erecta obtuse acuta. Ovarium breve minute pubescens.

Our house, Roraima.

131. STENOPTERA VISCOSA, Reichb. f. (Our house, 5400 ft.)

173. STENOPTERA ADNATA, Ridley, n. sp. (Plate XLVIII. A. figs. 1–6.) Tubera plura lanata elongata. Folia tenuia membranacea lanceolata acuta 3 uncias longa, $\frac{1}{2}$ unciam lata. Caulis validulus 17-uncialis superne pubescens, vaginis pluribus dissitis lanceolatis acuminatis usque ad basin fissis, longissima $1\frac{1}{2}$-uncialis. Racemus multiflorus densus pubescens. Flores parvi resupinati. Bracteæ lanceolatæ acutæ $\frac{3}{8}$-unciales floribus æquantes. Ovarium breve crassiusculum pubescens. Galea (sepalum posticum petalis adnatum) ovata cucullata obtusa, marginibus fimbriatis. Sepala lateralia oblonga ovata acuta. Labellum ovatum lanceolatum, lobis lateralibus tenuibus erectis vix distinctis, medio linguiformi carnoso, obtuso, supra canaliculato, basi subtus pubescenti. Columna elongata gracilis apice clavata, parte inferiore pubescente.

Upper slope.

9. PELEXIA APHYLLA, Ridley, n. sp. (Plate XLVIII. B. figs. 7–11.) Tubera desunt. Folia radicalia nulla, caulina lanceolata acuminata 6 dissita, superiora latiora. Caulis 8-uncialis pubescens præsertim versus basin. Flores pauci, mediocres, albi. Sepalum posticum petalis adnatum, galeam efformans, lanceolatam acuminatam cucullatam, petala quam sepalum breviora. Sepala lateralia lanceolata linearia porrecta marginibus involutis. Labellum cuneatum spathulatum obtusum minute pubescens, subemarginatum lobulo obscuro in medio; calcar ad ovarium arcte adnatum. Columna brevissima, rostellum prolongatum oblongum obtusum canaliculatum porrectum. Anthera lanceolata obtusa vix biloculata. Pollinia pyriformia bicrura; discus ovalis rotundatus.

Waetipoo Mountain; also Serra de Piedade, Minas Geraes, Brazil, *Gardner* (no. 5193, "Flowers white," in Herb. Brit. Mus.).

46. HABENARIA PARVIFLORA, Lindl. (Our house, 5400 ft.) Roraima 251, at 5000 ft.

367. HABENARIA MORITZII, Ridley, n. sp. Caulis $\frac{1}{2}$ ad pedalis foliatus. Folia erecta lanceolata acuta dissita, maxima 2 uncias longa, $\frac{1}{4}$ lata. Racemus laxus circiter 15-florus. Bracteæ lanceolatæ acuminatæ. Flores parvi. Sepalum posticum erectum, lateralia deflexa, ovata, lanceolata, mucronata. Petala bifida, lacinia postica erecta anguste linearis lanceolata, quam sepalum posticum paullo brevior, antica anguste linearis obtusa recurva. Labellum trilobum, lobi laterales filiformes quam medius longiores et angustiores. Calcar filiforme clavatum $\frac{1}{4}$ unciam longum. Columna majuscula. Anthera obtusa, apices breves recti. Lobi stigmatici crassiusculi obtusi breves.

At 4000 ft., Roraima; also in Venezuela, *Moritz* 630 *b*.

53. SELENIPEDIUM LINDLEYANUM, Reichb. f. (Our house, 5400 ft.) Roraima.

31. SELENIPEDIUM KLOTZSCHEANUM, Reichb. f. Colunga River.

315 or 311 (2 labels). TILLANDSIA STRICTA, var.? } J. G. Baker.
316. TILLANDSIA, sp.? Inadequate.
45. PUYA (probably new). (Inadequate.)
366. CIPURA PALUDOSA, Aubl.
28. SISYRINCHIUM ALATUM, Hook.

298. NIETNERIA CORYMBOSA, Klotzsch & Schomb. Top.

297. TOFIELDIA SCHOMBURGKIANA, Oliv., sp. nov. (Plate XLIX. A. figs. 1–6); foliis elongato-linearibus longe acuminatis minutissime ciliolatis longitudinaliter striatis basi distiche vaginantibus, scapo erecto tereti glabro foliis longioribus, floribus strictis racemosis pedicello erecto subæquilongis, calyculi bracteolis ovatis acutis perianthio 6-plo brevioribus, segmentis perianthii erectis oblongis acutis valide 5–7-striatis.

Roraima, 6000 ft., *Schomburgk*; summit, *E. F. im Thurn.*

Folia 3–12 poll. longa, $\frac{1}{8}$–$\frac{1}{4}$ poll. lata. Scapus $\frac{1}{3}$–2 ped. longus, 5–9 (3–∞)-florus. Flores flavido-virentes semipollicares; perianthii segmenta temp. florif. acutata persistentia rigida. Bracteæ ovato-lanceolatæ appressæ.

Nearly allied to *T. falcata*, Pers. (*T. frigida*, H. B. K.), from which it differs in its strict inflorescence and longer pedicels and flowers.

Schomburgk describes the leaves as margined with red.

257. XYRIS FONTANESIANA, Kunth. 5400 ft.

62. XYRIS SETIGERA, Oliv., sp. nov. (Plate L. A. figs. 1–8.) Subacaulis, foliis linearibus setoso-acuminatis marginibus minutissime setuloso-scabridis, scapo foliis 4–5-plo longiore stricto gracillimo subtereti glabro, capitulo ovoideo paucifloro bracteis coriaceis obtusis ovatis v. ovato-ellipticis, staminodiis ad faucem corollæ insertis bipartitis penicillatis, antheris filamento libero longioribus.

Roraima, 4000 ft., *E. F. im Thurn.*

Folia 1–2 poll. longa, $\frac{1}{24}$–$\frac{1}{20}$ poll. lata. Scapi 5–7 poll. longi, 1 v. 2 ex una radice; vagina carinata angusta foliis paullo longior. Bracteæ interiores cymbiformes oblongo-ellipticæ obtusæ v. emarginatæ, $\frac{1}{4}$ poll. longæ. Sepala lateralia linearia complicata anguste carinata, carina obsolete denticulata.

240. XYRIS WITSENIOIDES, Oliv., sp. nov. (Pl. L. B. figs. 9–15.) Caulescens, caule decumbente sub scapo sæpius dichotomo, foliis rigidis distiche arcte imbricatis linearibus longitudinaliter striatis glabris ad apicem acutissimum gradatim angustatis, basi vaginante scariosa spadicea, scapo gracili foliis 3–5-plo longiore, capitulis paucifloris, bracteis glabris obtusis v. interioribus majoribus emarginatis, sepalis lateralibus incurvis rigidis carinatis carina scabriuscula, staminodiis flabellatim dilatatis longe penicillato-plumosis, ovario apice rostrato, rostro persistente.

Roraima, ledge 7300 ft., *E. F. im Thurn.*

Folia $2\frac{1}{2}$ poll. longa, 1 lin. lata, leviter falcatim incurva. Scapus in dichotomiis solitarius compressiusculus v. subangulatus, 6–9 poll. longus; vagina foliis brevior. Capitula $\frac{1}{2}$ poll. longa, bracteis haud arcte imbricatis.

Singular in the *Witsenia*-like habit of its stout stems; in our specimens 3–4 inches (ranging to 6–8 inches, *E. F. im Thurn*) in length, lateral branches being given off immediately under the solitary scapes.

312. Abolboda Sceptrum, Oliv., sp. nov.; foliis lineari-lanceolatis acutis rigidis læte viridibus leviter glaucescentibus, scapo crassitie pennæ anserinæ, floribus capitatis, capitulis floriferis 4–5 poll. diam., bracteis ovatis acutis rigidis sepalis $\frac{1}{2}$–$\frac{2}{3}$ brevioribus, sepalis ovato-lanceolatis subæquilongis lateralibus carinatis, petalis limbo ovato flabellatim venoso, ovario ovoideo, stylo longo basi appendicibus 3 crassiusculis arcte uncinatis ovario æquilongis circumdato, ovula plurima.

Roraima, summit, *E. F. im Thurn.*

Folia 6–7 poll. longa. Scapus . . . . . Bracteæ ovatæ v. interiores ovato-lanceolatæ, $\frac{3}{4}$–$1\frac{1}{2}$ poll. longæ. Sepala $1\frac{1}{3}$–$1\frac{3}{4}$ poll. longa. Petala 2–$2\frac{1}{2}$ poll. longa, inferne in tubum leviter curvatum coalita. Stamina petalis breviora; filamenta anguste linearia; antheræ lineares. Ovarium cartilagineum, $\frac{1}{4}$ poll. longum; stylus $1\frac{3}{4}$ poll. longus.

The leaves I have not seen, Mr. im Thurn having kindly supplied me with a note of their size and form. He describes the foliage as "Yucca-like." Our specimen consists of a well-developed capitulum and 8–9 inches of its scape. The flowers hardly admit of being satisfactorily analyzed. They are very much larger than in other species seen by me, and the tube of the united petals much wider. The singular uncinate appendages are inserted with the style upon the ovary, not, as in some species, at a distinct interval above it. There is a figure of this remarkable plant in the Schomburgk collection of drawings at the British Museum.

338. Stegolepis guianensis, Klotzsch. 6000 ft.

34. Eriocaulon Humboldtii, Kunth? (= specimen from Roraima, *Schomburgk*). Arapoo R.

33. Pæpalanthus Schomburgkii, Klotzsch. Arapoo R.

60. Pæpalanthus flavescens, Koern. (*eriocephalus*, Klotzsch). 4000 ft.

294. Pæpalanthus Roraimæ, Oliv., sp. nov. (Plate XLIX. B. figs. 7–14.) Acaulis, foliis dense rosulatis brevibus rigidis linearibus obtusiusculis basi latioribus leviter falcatis rectisve, basi arcte imbricata lanuginosa excepta glabra, longitudinaliter striata, scapo solitario vaginato, vagina foliis subduplo longiore spathacea v. bifida glabra, involucri bracteis lineari-lanceolatis glabratis v. parce pilosis, fuliginosis, bracteis disci flores stipantibus oblanceolatis v. obovato-cuneatis cymbiformibus.

Roraima, summit, *E. F. im Thurn.*

Folia $\frac{3}{4}$–1 poll. longa. Scapus glabrescens v. apicem versus obsolete puberulus $3\frac{1}{2}$–$4\frac{1}{2}$ poll. longus. Capitula hemisphærica $\frac{1}{2}$ poll. diam. Flores breviter pedicellati. Perianthium segmentis exterioribus liberis obovatis concavis apicem versus coloratis interioribus staminigeris subæquilongis. Ovarium triquetrum.

264. Anthurium roraimense, N. E. Brown, sp. nov.; cataphyllis magnis lanceolatis, petiolis teretibus elongatis, lamina cordata subacuminata, lobis posticis semioblongis

quam antico subtriplo brevioribus sinu parabolico sejunctis, nervis primariis 13, venis primariis costa utrinque 6–7, omnibus supra et subtus prominentibus; pedunculo valido tereti; spatha oblongo-lanceolata, filiformi-acuminata; spadice stipitato spatha subæquante valido.

Hab. Roraima, British Guiana, *E. F. im Thurn.*

Cataphylla minora 3 poll. longa, majora 7–8 poll. longa, 1–1¼ poll. lata. Petiolus 2 ped. longus. Lamina 20 poll. longa, 12 poll. lata, pergamentacea, reticulato-venosa, nervi intramarginali margine valde approximato. Spatha 5½ poll. longa, 1¾ poll. lata. Spadix (cum stipite ½ poll. longa) 5 poll. longus, ½ poll. crassus. Flores 1 lin. diam., stylo conico brevissime exserto.—*N. E. Brown.*

382. Geonoma Appuniana, Spr.

358. Euterpe. 5400 ft.

CYPERACEÆ. By H. N. Ridley, Esq., M.A., F.L.S.

259. Fimbristylis hispidula, Kunth. (Our house, 5400 ft.) Roraima.

245. Rhynchospora glauca, Vahl. (Our house, 5400 ft.)

253. Rhynchospora capillacea, Torrey. (Our house, 5400 ft.)

Rhynchospora leptostachya, Bœckl. (Our house, 5400 ft.)

248. Scleria hirtella, Swartz.

209. Scleria bracteata, Cavanilles.

357. Cryptangium stellatum, Bœckeler, ♂. (Plate LI. figs. 1–6.) Upper slope, Roraima.

The male plant of this species does not seem to have been hitherto met with or described; I therefore add a description of it.

Panicula longissima, ramis gracilibus. Spiculæ plures, binæ, castaneæ, ¼ unciam longæ. Bractea lanceolata, trinervis, longe mucronata, mucrone ciliato. Glumæ vacuæ 8, floriferæ 2. Stamina tria, apiculis longis acuminatis, dimidio antheræ æquantibus.

Everardia, nov. gen. *Cryptangiearum.*

Herba perennis, caule valido descendente lignoso. Folia conferta rigida recurva. Culmus paniculatus validus lateralis, ex axilla folii inferioris oriens. Panicula laxa, rami plurimi inferiores masculi, supremi feminei. Spiculæ masculæ plurifloræ, glumis vacuis 3, floriferis 6. Stamina plura. Spiculæ femineæ parvæ, glumis vacuis 4, florifera 1. Stylus brevis, stigma bifidum lobis brevibus planis lanceolatis. Ovarium triangulatum breviter pedicellatum, cupula nulla. Setæ hypogynæ copiosæ tortæ.

335. Everardia montana, Ridley, n. sp. (Plate LII. figs. 1–8.) Caulis brevis, vaginis latis decompositis superne tectus. Folia lineari-lanceolata acuta acuminata carinata recurva, marginibus albo-ciliatis, longissima 7 uncias longa, ½ unciam lata. Culmus 14 uncias longus, validus, compressus, anceps, pro maxima parte paniculata, efoliata, vaginis paucis brunneis fissis compressis, sæpius lamina parva lanceolata obtusa

rigida. Spiculæ masculæ singulæ, copiosæ, $\frac{3}{8}$ unciam longæ, castaneæ, inferiores pedunculatæ. Glumæ 3 vacuæ, staminiferæ 6, lanceolatæ aristatæ, marginibus parce ciliatis, arista brevis crassiuscula. Stamina in flore circiter 6. Anthera acuminata filamento æqualis, $\frac{1}{4}$ unciam longa, apiculus brevissimus, trichomatum fasciculo terminali brevi. Spiculæ femineæ parvæ angustæ. Glumæ vacuæ 4, suprema fertilis, exteriores cartilagineæ lanceolatæ brevi-aristatæ, castaneæ, interiores scariosæ, carina violacea. Stylus stigmati æqualis, teres, crassiusculus brevis. Stigma breviter bifidum lobis lanceolatis obtusis planis, violaceis. Ovarium ellipticum oblongum obtuse triquetrum breviter pedicellatum, pedicello subtereti. Setæ hypogynæ, copiosæ, tortæ. Pistillum $\frac{1}{4}$-unciale; caryopsis fere $\frac{1}{8}$ unciam longa.

Ledge, Roraima.

This genus is most nearly allied to *Lagenocarpus*, but differs entirely from that genus, and from the rest of the *Cryptangieæ*, in the lateral inflorescence, the bifid stigma, with short flat lobes, the absence of any cupule, and the presence of a large number of hypogynous bristles.

262. Paspalum stellatum, Flügge, var.?
261. Panicum nervosum, Lam.? 5400 ft.
254. Arundinella brasiliensis, Raddi. 5400 ft.
154. Echinolæna scabra, H. B. K. 5400 ft.
246. Saccharum (§ Eriochrysis) cayennensis, Beauv. 5400 ft.
260. Ischæmum latifolium, Kunth. 5400 ft.
359. ? Guadua (barren). 5400 ft.
18. ? Chusquea (barren). Arapoo R.
302. Gram. dub. (barren). Top.

FERNS. By J. G. Baker, F.R.S., F.L.S.

The following is a complete list of the Ferns collected. The numbers are Mr. im Thurn's collecting-numbers. Those enclosed within brackets indicate the position of the new species in the sequence followed in our 'Synopsis Filicum.' In determining the species I have had the kind help of Mr. Jenman, the government botanist of the colony, who has paid special attention to Ferns ever since he has lived in Demerara.

343. Gleichenia pubescens, H. B. K., var. (G. longipinnata, Hook.). Upper slopes of the mountain.
92. Cyathea vestita, Mart. In the neighbourhood of the encampment.
270. Alsophila bipinnatifida, Baker. With a slender caudex 6 or 7 feet in length, in the neighbourhood of the encampment.

87 (16*). Alsophila macrosora, Baker, n. sp.; stipitibus basi paleis linearibus brunneis imbricatis dense vestitis, frondibus amplis deltoideis tripinnatifidis crassiusculis

præter venas primarias faciei superioris glabris, pinnis oblongo-lanceolatis, pinnulis lanceolatis inferioribus distincte petiolatis basi truncatis ad costam alatam pinnatifidis, segmentis tertiariis oblongis crenulatis, venis simplicibus erecto-patentibus 5–6-jugis, soris magnis globosis superficialibus intramarginalibus, receptaculis dense paraphysatis.

Basal paleæ extending 4–5 inches up the stipe, glossy, moderately firm in texture, the largest $\frac{1}{2}$ in. long. Stipe a foot long, brownish, deeply grooved down the face. Lower pinnæ 15–18 in. long, 8–9 in. broad. Lower pinnules 4 in. long $\frac{3}{4}$ in. broad, with a petiole $\frac{1}{6}$ in. long, which is articulated at the base. Tertiary segments $\frac{1}{6}$ in. broad.

Allied to the Bahian *A. præcincta*, from which it differs by its more coriaceous texture, crowded sori, and densely paraphysate receptacle.

37. Alsophila villosa, Presl.

318 (16*). Hymenophyllum dejectum, n. sp.; stipitibus productis paleis pallidis ascendentibus lanceolatis præditis, frondibus oblongo-lanceolatis tripinnatifidis erectis glabris, pinnis lanceolatis confertis decurvatis pinnulis, superioribus simplicibus inferioribus profunde pinnatifidis, segmentis ultimis linearibus integris uninervatis, soris breviter pedicellatis ad basin segmentorum ultimorum impositis, involucro campanulato valvis argute serratis.

Rootstock not seen. Stipes 2–3 in. long, clothed with minute inconspicuous pale membranous paleæ, as is also the rhachis. Lamina 4–5 in. long, $\frac{3}{4}$–1 in. broad. Pinnæ decurved, not more than $\frac{1}{2}$–$\frac{3}{4}$ in. long. Final segments $\frac{1}{12}$–$\frac{1}{8}$ in. long, not more than $\frac{1}{6}$ line broad. Involucre $\frac{1}{3}$ line broad.

A very distinct novelty. Allied to *H. demissum* and *H. javanicum*.

118, 199, 374. Hymenophyllum polyanthos, Sw. Upper slope of the mountain.

207, 302, 370, 372, 373. Hymenophyllum microcarpum, Hook. Upper slope of the mountain. This is evidently not more than a variety of *H. polyanthos*.

205. Hymenophyllum crispum, H. B. K. Upper slope of the mountain.

203, 375. Hymenophyllum lineare, Sw. Upper slope of the mountain; and 200, var. antillense, Jenman.

292. Hymenophyllum fucoides, Sw. Upper slopes of the mountain.

271. Trichomanes macilentum, Van den Bosch. Upper slopes of the mountain. Will have, I think, to be regarded as not more than a variety of *T. Bancroftii*.

198, 201, 349. Trichomanes pyxidiferum, L. Upper slopes of the mountain. 349 represents the variety *T. cavifolium*, C. Müll.

99, 347. Trichomanes crispum, Sw. The higher number from the upper slopes of the mountain, the lower from the neighbourhood of the encampment.

119. Trichomanes rigidum, Sw. Neighbourhood of the encampment.

120. Davallia Imrayana, Hook. Upper slopes of the mountain.

344. Lindsayana guianensis, Dryand. Upper slopes of the mountain.

149, 150, 301. LINDSAYA STRICTA, Dryand. The two lower numbers gathered near the encampment, the other on the mountain-top.

161, 303. HYPOLEPIS REPENS, Presl. Base of the cliff. 194, 195 are young forms of *Hypolepis*, most likely the same species.

144. PTERIS LOMARIACEA, Kunze. Neighbourhood of the encampment.

160. PTERIS INCISA, Thunb. Base of the cliff.

156. LOMARIA PLUMIERI, Desv. Upper slopes of the mountain.

88, 167. LOMARIA PROCERA, Spreng. Upper slopes of the mountain and in the neighbourhood of the encampment.

48. LOMARIA BORYANA, Willd. Neighbourhood of the encampment.

157, 369. ASPLENIUM LUNULATUM, Sw., var. (A. ERECTUM, Bory). Base of the cliff.

171. ASPLENIUM RHIZOPHORUM, L., var. (A. FLABELLATUM, Kunze). Upper slopes of the mountain.

143. ASPLENIUM FURCATUM, Thunb. Neighbourhood of the encampment.

272. ASPIDIUM CAPENSE, Willd. Path to the upper savannah.

275 (4*). NEPHRODIUM (§ LASTREA) BRACHYPODUM, n. sp.; caudice erecto, stipitibus brevissimis cæspitosis pilosis, frondibus parvis lanceolatis firmulis subglabris simpliciter pinnatis e medio ad basin et apicem sensim attenuatis, rhachide piloso paleis paucis patulis lanceolatis prædito, pinnis sessilibus lanceolatis basi utrinque auriculatis centralibus profunde serratis reliquis integris infimis deltoideis, venis superioribus pinnarum simplicibus erecto-patentibus, inferioribus furcatis vel parce pinnatis, soris superficialibus medialibus, involucro membranaceo subpersistente.

Frond 5–6 in. long, an inch broad, narrowed very gradually from the middle to both ends. Lower pinnæ not more than $\frac{1}{8}$ in. long. Stipes not above half an inch long. Central pinnæ $\frac{1}{8}$ in. broad above the dilated base.

Upper slopes of the mountain.

May be an involucrate form of the well-known West-Indian *Polypodium hastæfolium*, Sw., which it resembles very closely in size, shape, texture, and venation.

94, 380. NEPHRODIUM CONTERMINUM, Desv. Upper slopes of the mountain and neighbourhood of the encampment.

269. NEPHRODIUM LEPRIEURII, Hook. Neighbourhood of the encampment.

126, 169, 225. NEPHRODIUM DENTICULATUM, Hook. Upper slopes of the mountain and neighbourhood of the encampment.

354. NEPHRODIUM AMPLISSIMUM, Hook. Upper slopes of the mountain.

102, 339. NEPHROLEPIS CORDIFOLIA, Presl. Neighbourhood of the encampment.

356 (13*). POLYPODIUM (§ PHEGOPTERIS) DEMERARANUM, n. sp.; caudice erecto, stipite producto pubescente basi paleis paucis lanceolatis brunneis membranaceis prædito, frondibus oblongo-lanceolatis bipinnatifidis præsertim ad venas pilosis, pinnis sessilibus lanceolatis ad costam alatam pinnatifidis inferioribus reductis infimis remotis perparvis, pinnulis oblongo-lanceolatis integris obtusis, venulis simplicibus 8–9-jugis pilosis, soris superficialibus parvis supramedialibus.

Stipes 6–8 in. long below the much-dwarfed lowest pair of pinnæ, grey and pubescent, as is the rhachis. Largest basal paleæ half an inch long. Lamina $1\frac{1}{2}$–2 ft. long, 7–8 in. broad at the middle. Largest pinnæ 4–$4\frac{1}{2}$ in. long, about an inch broad. Pinnules above $\frac{1}{8}$ in. broad.

Closely allied to the Himalayan *P. auriculatum*, Wall., in size, texture, and cutting, but quite different in the position of the sori. Found on the upper slopes of the mountain. Gathered previously by Appun, 1138.

168 (15*). Polypodium (§ Phegopteris) roraimense, n. sp.; caudice erecto, stipite producto glabro stramineo, frondibus oblongo-lanceolatis bipinnatis præter costas faciei superioris glabris, pinnis sessilibus lanceolatis simpliciter pinnatis inferioribus reductis infimis remotis perparvis, pinnulis oblongo-lanceolatis subintegris obtusis, venulis 7–8-jugis ascendentibus simplicibus, soris globosis superficialibus supramedialibus.

Stipes 3–4 in. long below the dwarfed lowest pinnæ. Lamina $1\frac{1}{2}$ ft. long, 8–9 in. broad at the middle. Largest pinnæ 4–$4\frac{1}{2}$ in. long, about an inch broad. Pinnules $\frac{1}{6}$ in. broad.

Closely allied to the preceding and to the West-Indian *P. Germanianum* and *ctenoides*. Gathered upon the upper slopes of the mountain.

177, 182, 282, 307, 345, 352, 376. Polypodium marginellum, Sw. Upper slopes of the mountain, in the crevices of rocks.

184 (ex parte). Polypodium trifurcatum, L. Upper slopes of the mountain, mixed with *Enterosora Campbellii*.

166, 350, 368, 377. Polypodium furcatum, Mett. Summit and upper slopes of the mountain.

133. Polypodium serrulatum, Mett. The type in the neighbourhood of the encampment, and no. 351, var. (*Xiphopteris Jamesoni*, Hook.), on the upper slopes of the mountain.

178. Polypodium trichomanoides, Sw. Upper slopes of the mountain.

348. Polypodium truncicola, Klotzsch. Upper slopes of the mountain. New to Guiana.

181. Polypodium moniliforme, Lag., var. (P. saxicolum, Baker). Upper slopes of the mountain.

179. Polypodium tovarense, Klotzsch. Upper slopes of the mountain.

186 (159*). Polypodium (§ Eupolypodium) Kalbreyeri, n. sp.; rhizomate breviter repente paleis parvis patulis linearibus brunneis vestito, stipitibus contiguis elongatis erectis atro-brunneis, frondibus deltoideis simpliciter pinnatis coriaceis glabris, rhachide nudo castaneo, pinnis linearibus adnatis contiguis integris superioribus sensim minoribus, venis immersis occultis furcatis, soris globosis superficialibus latitudinem totam pinnarum inter costam et marginem occupantibus.

Stipes 8–10 in. long, naked or furnished towards the base with minute, squarrose, soft, hair-like paleæ. Rhachis castaneous, like the stipe. Lamina 5–6 in. long, 3–$3\frac{1}{2}$ in. broad at the base. Pinnæ about 20 on a side below the caudate apex of the frond, $\frac{1}{6}$ in. broad at the base, narrowed gradually to an acute point. Sori a line in diameter, 12–16-jugate on the lower pinnæ.

Nearest the Andine *P. melanopus*, Hook. & Grev., from which it differs by its stiffly erect stipes, frond broadest at the base, and obscure immersed veins. Found on the upper slopes of the mountain, and gathered previously by Kalbreyer on the mountains of the province of Ocana, in New Granada, at an elevation of 6500 ft.

186* (159*). POLYPODIUM KOOKENAMÆ, Jenman MSS., n. sp.; rhizomate valido breviter repente vel suberecto paleis subulatis castaneis ciliatis dense vestito, stipitibus castaneis elongatis parce ciliatis, frondibus oblongo-lanceolatis subcoriaceis glabris simpliciter subpinnatis, rhachide primario anguste alato, pinnis lanceolatis acutis integris basi confluentibus, costis immersis, venis furcatis, soris medialibus obscure immersis.

Stipes 6–9 in. long. Lamina 6–8 in. long, 2 in. broad, truncate at the base, dark green above, pale beneath. Pinnæ 16–20 on a side below the subentire acuminate apex of the frond, the largest an inch long, $\frac{1}{5}$–$\frac{1}{4}$ in. broad. Primary rhachis purpuraceous on both sides of the frond. Sori terminal on the anterior fork of each vein.

This I have not seen, and insert entirely on Mr. Jenman's authority. I have merely altered the form of the description which he has sent, so as to make it uniform with the others. It did duty for no. 186 in set C of the distribution. Mr. Jenman says it is intermediate between *P. Kalbreyeri* and the Jamaican *P. brunneo-viride*.

180, 379. POLYPODIUM TAXIFOLIUM, Linn. Upper slopes of the mountain.

104. POLYPODIUM PECTINATUM, Linn. In the neighbourhood of the encampment.

124. POLYPODIUM CULTRATUM, Willd. In the neighbourhood of the encampment.

217. POLYPODIUM XANTHOTRICHIUM, Klotzsch (*P. ellipticosorum*, Fée). Upper slopes of the mountain. Appears to be distinct specifically from *P. cultratum* by its uniformly elliptical sori.

281. POLYPODIUM RIGESCENS, Bory. Upper slopes of the mountain.

176. POLYPODIUM FIRMUM, Klotzsch. Upper slopes of the mountain.

378. POLYPODIUM SUBSESSILE, Baker. Upper slopes of the mountain.

190. POLYPODIUM CAPILLARE, Desv. Upper slopes of the mountain.

125 (212*). POLYPODIUM (§ EUPOLYPODIUM) MELANOTRICHUM, n. sp.; caudice erecto paleis subulatis crispatis vestito, stipite brevissimo gracillimo, frondibus oblongo-lanceolatis parvis flaccidis membranaceis glabris bipinnatifidis, pinnis lanceolatis adnatis profunde pectinato-pinnatifidis inferioribus sensim minoribus, segmentis deltoideis acutis, venis brevibus simplicibus erecto-patentibus, soris globosis superficialibus costularibus ad apicem venarum impositis.

Stipes and rhachis black, thread-like, glabrous. Lamina 3–4 in. long, an inch broad at the middle. Central pinnæ half an inch long, $\frac{1}{8}$ in. broad, with 6–8 pairs of deltoid segments with a single sorus in the centre of each.

Allied to the Brazilian *P. achilleæfolium*, Kaulf., but quite different in texture, in the shape of the segments, and by its very short simple veins. Found in the neighbourhood of the encampment.

172. POLYPODIUM (§ GONIOPHLEBIUM) LORICEUM, Linn. Base of the great cliff.

340. POLYPODIUM (§ PHLEBODIUM) AUREUM, Linn., var. (P. AREOLATUM, H. B. K.). In the neighbourhood of the encampment.

208. POLYPODIUM (§ CAMPYLONEURON) ANGUSTIFOLIUM, Sw., var. (P. AMPHOSTEMON, Kunze). In the neighbourhood of the encampment.

295 (14*). GYMNOGRAMME (§ PTEROZONIUM) CYCLOPHYLLA, n. sp. (Plate LIII. figs. 1, 2); caudice erecto, stipitibus cæspitosis elongatis erectis basi primum paleis minutis lineari-subulatis patulis præditis, frondibus parvis nitidis rigide coriaceis apice rotundatis margine recurvato basi cuneatis margine plano, venis flabellatis immersis, soris oblongis ad venarum apicem solum productis cite confluentibus zonam angustam intramarginalem formantibus.

Stipes wiry, 5–6 in. long. Lamina only about an inch long and broad. Found on the summit of the mountain.

101, 215 (14*). GYMNOGRAMME (§ PTEROZONIUM) ELAPHOGLOSSOIDES, n. sp. (Plate LIV. figs. 1–5); caudice valido lignoso paleis parvis subulatis nigro-castaneis dense vestito, stipitibus elongatis erectis nudis castaneis, frondibus simplicibus integris rigide coriaceis nudis elliptico-lanceolatis acutis vel obtusis conspicue costatis basi cordatis, venis confertis patulis parallelis simplicibus vel furcatis intra marginem evanescentibus, soris linearibus cite confluentibus frondis faciem totam inferiorem præter zonam angustam marginalem occupantibus.

Stipes wiry, sometimes above half a foot long. Fronds 6–8 in. long, fertile 1–2 inches, sterile sometimes 3 inches broad. Sori occupying the whole under surface except a marginal border. Not more than $\frac{1}{8}$–$\frac{1}{12}$ in. broad. Found both upon the upper slopes of the mountain and in the neighbourhood of the encampment.

These two interesting novelties both fall under the genus *Pterozonium* of Fée, figured on tab. 16 of his 'Genera Filicum.' The only species known previously is the very rare *Gymnogramme reniformis*, Mart., figured Icon. Crypt. Bras. t. 26, and also in Hooker's 'Second Century of Ferns,' t. 9, and on tab. 49 of the Fern volume of 'Flora Brasiliensis.' The two new species are very distinct, both from one another and *G. reniformis*. In *G. cyclophylla* the sori form a narrow band just within the margin; in *G. reniformis* a broad semicircle, a distinct space within the margin, whilst in *G. elaphoglossoides* they cover the whole surface except a narrow border.

164. GYMNOGRAMME SCHOMBURGKIANA, Kunze. Upper slopes of the mountain.

197. GYMNOGRAMME HIRTA, Desv. Upper slopes of the mountain. New to Guiana.

159. GYMNOGRAMME FLEXUOSA, Desv. Upper slopes of the mountain. Also new to Guiana.

ENTEROSORA, nov. gen.

Sori oblongi vel oblongo-cylindrici exindusiati ad venas decurrentes, intra frondis laminam orti, demum ad frondis faciem inferiorem rimis angustis obliquis imperfecte obvii. Venæ pinnatæ, venulis paucis ascendentibus prope frondis marginem anastomosantibus et areolas steriles hexagonas soro unico centrali includentes formantibus.

Most resembles *Gymnogramme*, from which it differs mainly by having the sori immersed in the centre of the frond, and only appearing very partially on its lower surface even in a mature stage.

184 (ex parte). ENTEROSORA CAMPBELLII, Baker. (Plate LV. figs. 1–5.)

The only species: upper slopes of the mountain, with *Polypodium trifurcatum*. Rootstock cylindrical, suberect, densely clothed with small brown membranous lanceolate paleæ. Stipes slender, brown, erect, wiry, 4–5 in. long, with a few very inconspicuous spreading fibrillose paleæ downwards. Lamina oblanceolate, simple, subcoriaceous, glabrous, 6–8 in. long, under an inch broad, obtuse, narrowed gradually to the base, conspicuously repand on the margin, with broad rounded lobes. Veins very distinct when the frond is held up to the light, arranged in pinnate groups, one opposite each lobe, the sterile veinlets forming unequal hexagonal areolæ, with a single vein bearing a sorus in the centre of each. Sori $\frac{1}{8}$–$\frac{1}{6}$ in. long, 4–6 to each of the central pinnated groups, erecto-patent as regards the whole lamina, seen partially at last on the lower surface by slits that seem as if they were made with a knife through the epidermis.

Frond in shape and texture much resembling that of *Polypodium trifurcatum*, from which it differs by its long stipes and totally different veining, in addition to the entirely dissimilar shape and position of its sori. In naming it after the late W. H. Campbell, Esq., I am carrying out the wish of Mr. im Thurn.

170. VITTARIA LINEATA, Sw. Upper slopes of the mountain.

212, 218. VITTARIA STIPULATA, Kunze. Upper slopes of the mountain. New to Guiana.

229, 231. ACROSTICHUM LATIFOLIUM, Sw. Upper slopes of the mountains. Two different varieties, both rigid in texture, narrowed very gradually from the middle to the base, and 229 dotted over the under surface with minute subpeltate brown paleæ.

233, 238. ACROSTICHUM LINGUA, Raddi.

267. ACROSTICHUM STENOPTERIS, Klotzsch. In the neighburhood of the encampment. New to Guiana.

266. ACROSTICHUM DECORATUM, Kunze. In the neighbourhood of the encampment.

278. ACROSTICHUM AUBERTII, Desv., var. CRINITUM, nov. var. Recedes from the Brazilian and Colombian type of the species towards *A. villosum* by its much more crinite lamina both in the sterile and fertile frond, and by the stipes being densely clothed with squarrose subulate brown paleæ, as in the Venezuelan *A. Reichenbachii*, Moritz. Path to the upper slope. The species is new to Guiana.

237 (45*). ACROSTICHUM (§ ELAPHOGLOSSUM) LEPTOPHLEBIUM, n. sp.; rhizomate repente cylindrico lignoso paleis parvis membranaceis lanceolatis brunneis crispatis dense vestito, stipite elongato stramineo subnudo, fronde sterili lanceolato membranaceo glabro paleis paucis lanceolatis ad marginem et faciem inferiorem prædito, venis laxis perspicuis erecto-patentibus simplicibus vel furcatis intra marginem terminantibus, fronde sterili multo minore, stipite longiore.

Sterile lamina a foot or more long, 18–20 lines broad, cuneate at the base, with a slender fragile stipe 4–5 inches long. Fertile lamina 4–5 inches long, an inch broad, with a stipe about a foot long. Found upon the upper slopes of the mountain.

93. ACROSTICHUM MUSCOSUM, Sw., var. A. ENGELII, Karst. In the neighbourhood of the encampment.

213. ACROSTICHUM SQUAMOSUM, Sw. Upper slopes of the mountain.

41. ACROSTICHUM (§ RHIPIDOPTERIS) PELTATUM, Sw. In the neighbourhood of the encampment.

100. SCHIZÆA DICHOTOMA, Sw. In the neighbourhood of the encampment. New to Guiana.

85. SCHIZÆA ELEGANS, Sw. In the neighbourhood of the encampment.

263. ANEMIA TOMENTOSA, Sw. In the neighbourhood of the encampment.

146. LYCOPODIUM ALOPECUROIDES, L. In the neighbourhood of the encampment.

192. LYCOPODIUM LINIFOLIUM, L., var. SARMENTOSUM RUBESCENS, Spring. Upper slopes of the mountain.

230. LYCOPODIUM SUBULATUM, Desv. Base of the cliff.

226 (159*). SELAGINELLA (§ STACHYGYNANDRUM) VERNICOSA, n. sp. (Plate LVI. A. figs. 1–7); caule basi decumbente superne recto laxe pinnato, ramulis paucis brevibus ascendentibus, foliis heteromorphis distichis crassis firmis nitide viridibus, planæ inferioris confertis erecto-patentibus ovatis obtusis margine ubique denticulatis planæ superioris duplo brevioribus ascendentibus ovatis obtusis valde imbricatis, spicis tetragonis brevissimis, bracteis conformibus magnis ovatis acutis.

This belongs to the *Atrovirides* group in the neighbourhood of *S. Martensii.* The main stems are about half a foot long, the leafy branches an eighth of an inch broad, and the leaves of the lower plane a line long. The type (A. figs. 1–7) as described was found at the base of the cliff, and a variety (No. 381) (B. fig. 8, var. *oligoclada*), with much fewer more elongated branches, near the encampment.

122 (186*). SELAGINELLA (§ STACHYGYNANDRUM) RORAIMENSIS, n. sp. (Plate LVI. C. figs. 9–14); caule erecto 3–4-pinnato, ramis laxe dispositis ascendentibus ramulis brevibus, foliis heteromorphis distichis membranaceis, planæ inferioris laxis oblongo-lanceolatis acutis valde inæquilateralibus basi superiore producto late rotundato, planæ superioris ovatis ascendentibus cuspidatis, spicis tetragonis, bracteis conformibus ovatis acutis valde imbricatis acute carinatis sporangiis duplo longioribus.

Belongs to the *Radiatæ* group in the neighbourhood of *S. radiata* and *confusa.* The main stems are 4 or 5 inches long, the leafy branches $\frac{1}{6}$ in. broad, and the leaves of the lower plane a line long. Found in the neighbourhood of the encampment.

(271*.) SELAGINELLA (§ HETEROSTACHYS) RHODOSTACHYA, n. sp.; caule decumbente, ramis alternis deltoideis flabellato-bipinnatis, foliis heteromorphis distichis membranaceis, planæ inferioris laxe dispositis erecto-patentibus ovatis obtusis paulo inæquilateralibus, planæ superioris consimilibus duplo minoribus valde ascendentibus, spicis brevissimis platystachyoideis, bracteis dimorphis ovatis acutis membranaceis.

Belongs to the group *Proniflorœ* in the neighbourhood of *S. consimilis* and *Otonis*. The stems are half a foot in length, and the leafy branches $\frac{1}{8}$ in. broad. This was contained in the collection without any number.

MUSCI. By Mr. W. MITTEN, A.L.S.

HOOKERIA (§ OMALIADELPHUS) CRISPA, C. Müll. Bot. Zeit. 1855, p. 768. Perfectly fruited, near encampment, no. 123.

HYPOPTERYGIUM TAMARISCI, Brid.; *Hypnum Tamarisci*, Sw.; Hedw. Musc. Frond. t. 51. Without fruit. Near encampment, no. 265.

POLYTRICHUM ARISTIFLORUM, Mitt. Journ. Linn. Soc., Bot. vol. xii. p. 620. A few barren stems, near encampment, no. 116.

Creeping over the roots of this are a few stems of *Jungermannia perfoliata*, Swartz, or of one of the closely allied South-American species of the little group to which Mr. Spruce has applied the name *Syzygiella* in the 'Journal of Botany,' 1876, intending it to include *Jungermannia perfoliata*, *J. contigua*, and *J. concreta*, Gottsche, *J. plagiochiloides* and *J. pectiniformis*, Spruce, also *J. macrocalyx*, Mont.; to these must be added *J. geminifolia*, Mitt., Journ. Linn. Soc., Bot. vol. vii. p. 164, from tropical Africa, and the *J. subintegerrima*, Reinw. Bl. et Nees, Hep. Jav. in the 'Synopsis Hepaticorum,' placed in *Plagiochila* (p. 55). To this species belong *P. variegata*, Lindenb., *P. variabilis*, Lacoste, and also *P. securifolia*, Lindenb. Sp. Hep. t. x., all of which have the leaf-angles united on both sides of the stem, even when they are not opposite, a characteristic which is not mentioned in their original descriptions, or depicted in their figures, nor in that of the *J. macrocalyx* as found in the 'Synopsis.' The perianth in *J. subintegerrima* agrees with that found in the species allied to *J. colorata*, and, as in their case, is subtended by shortened and dentate involucral leaves. Exactly similar instances of conjugation of the leaf-angles are found in *Plagiochila*, some of which do not otherwise resemble each other.

PLAGIOCHILA ADIANTOIDES, Lindenb. Male stems only, upper slope, no. 283.

ANEURA BIPINNATA, Nees (*Jungermannia*, Sw.). Specimens taken from large tufts, upper slopes, nos. 204, 284.

In these specimens the stems are 4–5 cm. high, including the side branches 1 cm. wide, the ultimate ramuli with a limb of about two rows of more pellucid cells; in *A. fucoides*, Hook. Musc. Exot. t. 85, this limb is very much wider; in *A. Poeppigiana* it is nearly or quite obsolete. Besides these there are several other remarkable South-American species: *A. alata*, Gottsche, from Chili, a very large species; *A. prehensilis*, Hook. f. et Tayl. Fl. Ant. t. 160. fig. 9 (under *Jungermannia*), originally from Hermite Island, since collected by Cunningham, with stems nearly six inches high, and always with its pruinose look when dry; *A. polyclada*, Mitt., gathered in Otway Harbour, Patagonia, during the visit of the 'Challenger' Expedition, a small species about an inch and a half high (frons dorso planus lævis, ramis valde approximatis bipinnatis, ventre ramulis curvulis crispulis telam spongiosam formantibus, margine ubique limbo e cellularum 3–4 lato pellucidiore distincto); *A. polyptera*, Mitt., from Magellan, collected in Cockle Cove by Dr. Coppinger, H.M.S. 'Alert' (frons 10 cm. alt., 2 cm. lat., ramis approximatis tripinnatis ubique lamina 5–6 cell. lata, limbatus dorso planus lævis ventre præcipue in ramis ramulisque lamellis angustis longitudinalibus vestitus); and *A. denticulata*, Mitt., from the Andes of Bogota, gathered amongst mosses by Weir (frons 5–6 cm. altus cum ramulis 1 cm. latus, ramis remotiusculis bipinnatis ubique limbo pellucidiore cell. 4 lato margine denticulis divaricatis angustis subciliatus). All these species show that in South America there is a development of larger forms than are yet known elsewhere.

Blepharozia Roraimæ. Folia erecto-patentia imbricata, cochleariformi-concava integerrima e lobulato obtusa; involucralia conformia, perianthia (abortiva) cylindracea abrupta obtusissima, ore parvo rotundo.

From the top of Roraima, one stem only.

Entire plant of a dark red-brown colour, about 4 cm. high; it is divided below into two, one branch being again forked, the leaves are imbricated in bifarious order and are repeatedly in interrupted series; each innovation arises from towards one side of the dorsal base of the perianth with small leaves, which increase rapidly in size upwards, the largest being the involucral, here the greatest diameter is about 4 mm.: the perianths are also about 4 mm. long, and of these as many as four are observable on the undivided stem, and as each innovation arises from the same position, they stand at the side of the stem rather towards the ventral side; in all particulars they closely resemble the abortive perianths seen on *B. sphagnoides* and other species; the young innovation also closely agrees with that of the male amenta of that species; but there is no trace of the lobule, which is not, as has been supposed, distinct from the leaf in *B. cochleariformis*, but is seen, from being an almost closed sac in some species, to be opened out in *B. evoluta*.

DESCRIPTION OF THE PLATES.

Plate XXXVII.

Figs. 1–8. (A.) *Leitgebia Imthurniana*, Oliver, sp. n. 1, plant in flower; 2, leaf; 3, pedicel and calyx; 4, bract; 5, corona; 6, two stamens and segment of corona; 7, pistil; 8, transverse section of ovary.

Figs. 9–17. (B.) *Bonnetia Roraimæ*, Oliver, sp. n. 9, plant in flower; 10, leaf; 11, flower; 12, calyx; 13, petal; 14, phalange of stamens; 15, a back and front view of stamen; 16, pistil; 17, transverse section of ovary.

Figs. 1 and 9 reduced sketches, fig. 8 nat. size; all the other figures enlarged.

Plate XXXVIII.

Figs. 1–6. (A.) *Ravenia ruellioides*, Oliver, sp. n. 1, portion of plant in flower; 2, calyx and pistil; 3, corolla, laid open; 4, anther, back and front; 5, pistil; 6, vertical section of ovary and disk. All enlarged.

Figs. 7–13. (B.) *Myrcia* (§ *Aulomyrcia*) *Roraimæ*, Oliver, sp. n. 7, plant; 8, bud; 9, expanded flower; 10, calyx, the petals and stamens removed; 11, stamen, back and front; 12, longitudinal section of ovary and calyx-tube; 13, transverse section of ovary.

Plate XXXIX.

Figs. 1–9. (A.) *Myrtus stenophylla*, Oliver, sp. n. 1, plant in flower and fruit; 2 & 3, leaf, above and below; 4, expanded flower; 5, calyx and bracteoles; 6, stamen, front and back view; 7, transverse section of ovary; 8, fruit; 9, seed. All enlarged.

Figs. 10–18. (B.) *Microlicia bryanthoides*, Oliver, sp. n. 10, plant in flower and fruit; 11, leaves; 12, bud; 13, expanded flower; 14, longer, 15, shorter stamens; 16, apex of ovary and style; 17, fruit; 18, seed. All enlarged.

Plate XL.

Figs. 1–6. *Crepinella gracilis*, March., sp. n. 1, plant in flower; 2, bud; 3, expanded flower; 4, stamen, front and back view; 5, calyx-tube and ovary; 6, longitudinal section of ovary. All enlarged.

Plate XLI.

Figs. 1–8. *Sciadophyllum coriaceum*, March., sp. n. 1, plant in flower; 2, bud; 3, coherent petals; 4, petal apart; 5, anther, back and front; 6, ovary; 7, transverse section of ovary; 8, young fruit. All enlarged.

Plate XLII.

Figs. 1–7. (A.) *Psychotria Imthurniana*, Oliver, sp. n. 1, plant in flower; 2, stipules; 3, expanded flower; 4, corolla, laid open; 5, stamen, back and front; 6, ovary and style; 7, longitudinal section of ovary.

Figs. 8–15. (B.) *Psychotria concinna*, Oliver, sp. n. 8, plant in flower; 9, stipules; 10, flower; 11, corolla, laid open; 12, anther, back and front; 13, ovary and style; 14, epigynous disk; 15, longitudinal section of ovary. All enlarged.

Plate XLIII.

Figs. 1–8. (A.) *Baccharis Vitis-Idæa*, Oliver, sp. n. 1, male plant, and 2, female plant; 3, male capitulum; 4, floret; 5, seta of pappus; 6, stamens; 7, style; 8, female floret. All enlarged.

Figs. 9–16. (B.) *Calea ternifolia*, Oliver, sp. n. 9, plant in flower; 10 & 11, scales of involucre; 12, palea of receptacle; 13, floret; 14, seta of pappus; 15, anthers; 16, style. All enlarged.

Plate XLIV.

Figs. 1–6. (A.) *Ledothamnus guyanensis*, Meissn. 1, plant in flower; 2 & 3, leaves; 4, sepal; 5, stamens, front and back view; 6, pistil. All enlarged.

Figs. 7–11. (B.) *Utricularia* (§ *Orchidioides*) *Campbelliana*, Oliver, sp. n. 7, different views of plant in flower, 8, ampullæ; 9, calyx-lobe; 10, lower lip of corolla and spur ?; 11, stamens. All enlarged.

Plate XLV.

Figs. 1 & 2. *Tabebuia Roraimæ*, Oliver, sp. n. 1, plant in flower; 2, stamens. All enlarged.

Plate XLVI.

Figs. 1–6. (A.) *Epidendrum Imthurnii*, Ridley, sp. n. 1, plant in flower; 2, flower; 3, labellum and column, front view; 4, ditto, side view; 5, anther-case; 6, pollinia. All enlarged.

Figs. 7–10. (B.) *Epidendrum violascens*, Ridley, sp. n. 7, plant in flower; 8, expanded flower; 9, same, posterior sepal and lateral petal attached; 10, fruiting specimen. Figs. 7 and 10 about nat. size, 8 and 9 are enlarged.

Plate XLVII.

Figs. 1–6. *Zygopetalum venustum*, Ridley, sp. n. 1, plant in flower; 2, labellum and column; 3, labellum, side view; 4, column; 5, anther-case; 6, pollinium. All enlarged.

Plate XLVIII.

Figs. 1–6. (A.) *Stenoptera adnata*, Ridley, sp. n. 1, plant in flower; 2, flower; 3, labellum; 4, column; 5, same, side view; 6, pollen. All enlarged.

Figs. 7–11. (B.) *Pelexia aphylla*, Ridley, sp. n. 7, plant in flower; 8, expanded flower; 9, longitudinal section of perianth-tube, with labellum; 10, column; 11, pollen. All enlarged.

Plate XLIX.

Figs. 1–6. (A.) *Tofieldia Schomburgkiana*, Oliver, sp. n. 1, plant in flower; 2, fragment of leaf, showing ciliolate margin; 3, flower; 4, stamen; 5, pistil; 6, transverse section of ovary. All enlarged.

Figs. 7–14. (B.) *Pæpalanthus Roraimæ*, Oliver, sp. n. 7, plant; 8, outer smaller, and inner larger involucral bracts; 9, staminate flower and bracteole; 10, same, expanded; 11, inner perianth-segment and adnate stamen; 12, stamen, back and front view; 13, pistillate flower; 14, pistil. All enlarged.

Plate L.

Figs. 1–8. (A.) *Xyris setigera*, Oliver, sp. n. 1, plant in flower; 2, fragment of leaf, showing setose margin; 3, involucral bract; 4, flower; 5, perianth, laid open; 6, stamen; 7, penicillate staminodia; 8, style-branches. All enlarged.

Figs. 9–15. (B.) *Xyris witsenioides*, Oliver, sp. n. 9, plant in flower; 10 & 11, involucral scales; 12, perianth, laid open; 13, 13 *a*, anthers, back and front; 14, staminode; 15, pistil. All enlarged.

Plate LI.

Figs. 1–6. *Cryptangium stellatum*, Bœckl. 1, plant; 2, branchlet of inflorescence; 3, spikelet; 4 & 5, outer and inner glumes; 6, anther. All enlarged.

Plate LII.

Figs. 1–8. *Everardia montana*, Ridley, sp. n. 1, plant; 2, branchlet of inflorescence; 3, male spikelet; 4, florets; 5, glume; 6, stamens; 7, female spikelet; 8, pistil and hypogynous setæ. Fig. 1 about nat size, all others enlarged.

Plate LIII.

Figs. 1, 2. *Gymnogramme* (§ *Pterozonium*) *cyclophylla*, Baker, sp. n. 1, plant; 2, portion of frond, enlarged.

Plate LIV.

Figs. 1–5. *Gymnogramme* (§ *Pterozonium*) *elaphoglossoides*, Baker, sp. n. 1, upper, 2, lower surface of frond; 3, palea; 4, portion of frond, showing venation and position of sori; 5, rootstock. Figs. 3 and 4 enlarged.

Plate LV.

Figs. 1–5. *Enterosora Campbellii*, Baker, gen. nov. 1, plant; 2, palea; 3, portion of frond, showing venation and sori; 4, horizontal section of a frond; 5, portion of same, much enlarged.

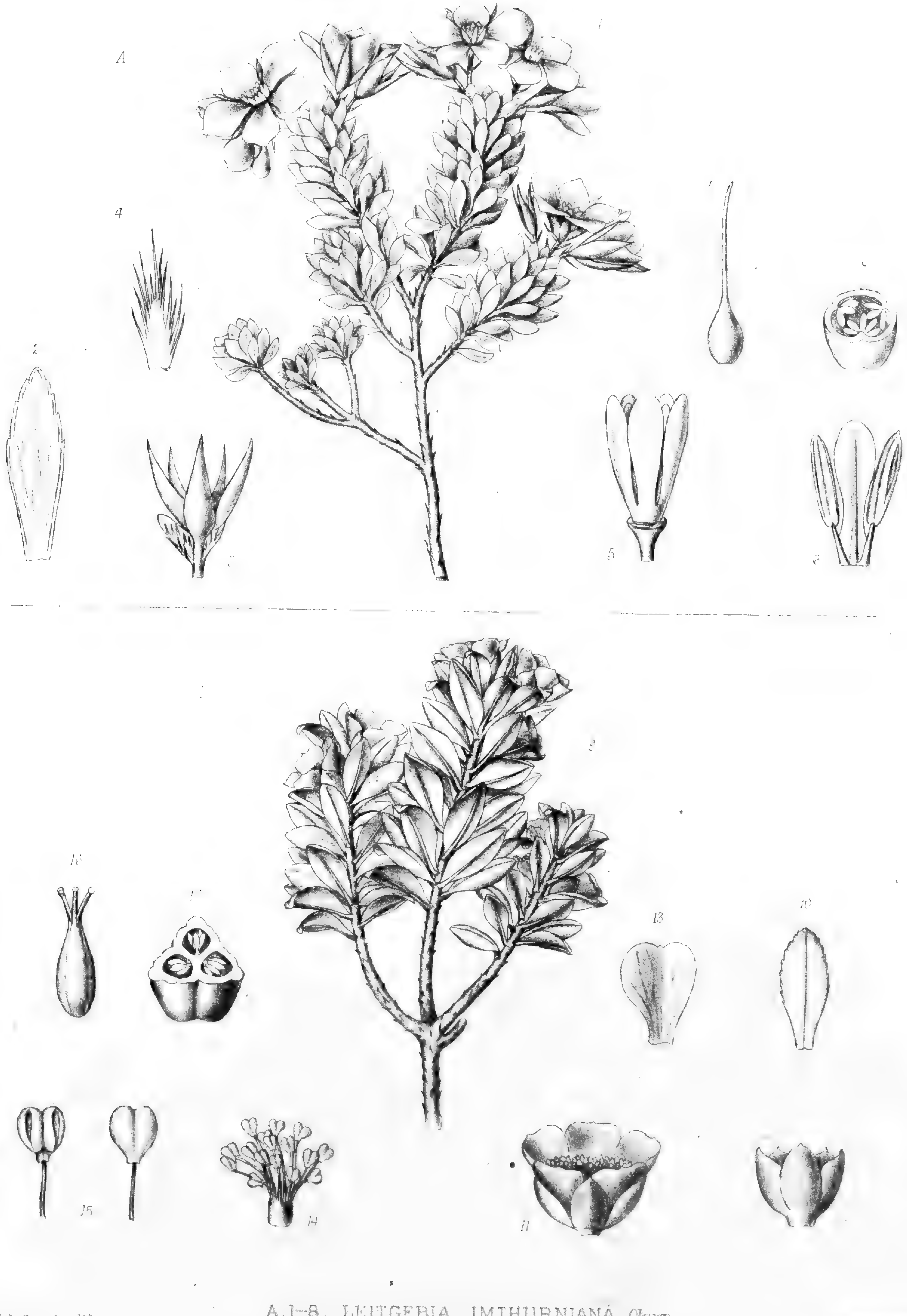
Plate LVI.

Figs. 1–7. (A.) *Selaginella* (§ *Stachygynandrum*) *vernicosa*, Baker, sp. n. 1, plant; 2, fertile branch; 3, front view of portion of stem, and 4, back view of same; 5, stipule (or smaller leaf); 6, bract; 7, capsule.

Fig. 8. (B.) *Selaginella* (§ *Stachygynandrum*) *vernicosa*, var. *oligoclada*.

Figs. 9–14. (C.) *Selaginella* (§ *Stachygynandrum*) *roraimensis*, Baker, sp. n. 9, plant; 10, fertile branch; 11, back of stem; 12, leaf; 13, stipule; 14, bract with capsule.

Figs. 1, 8, and 9 of natural size, all the others enlarged.



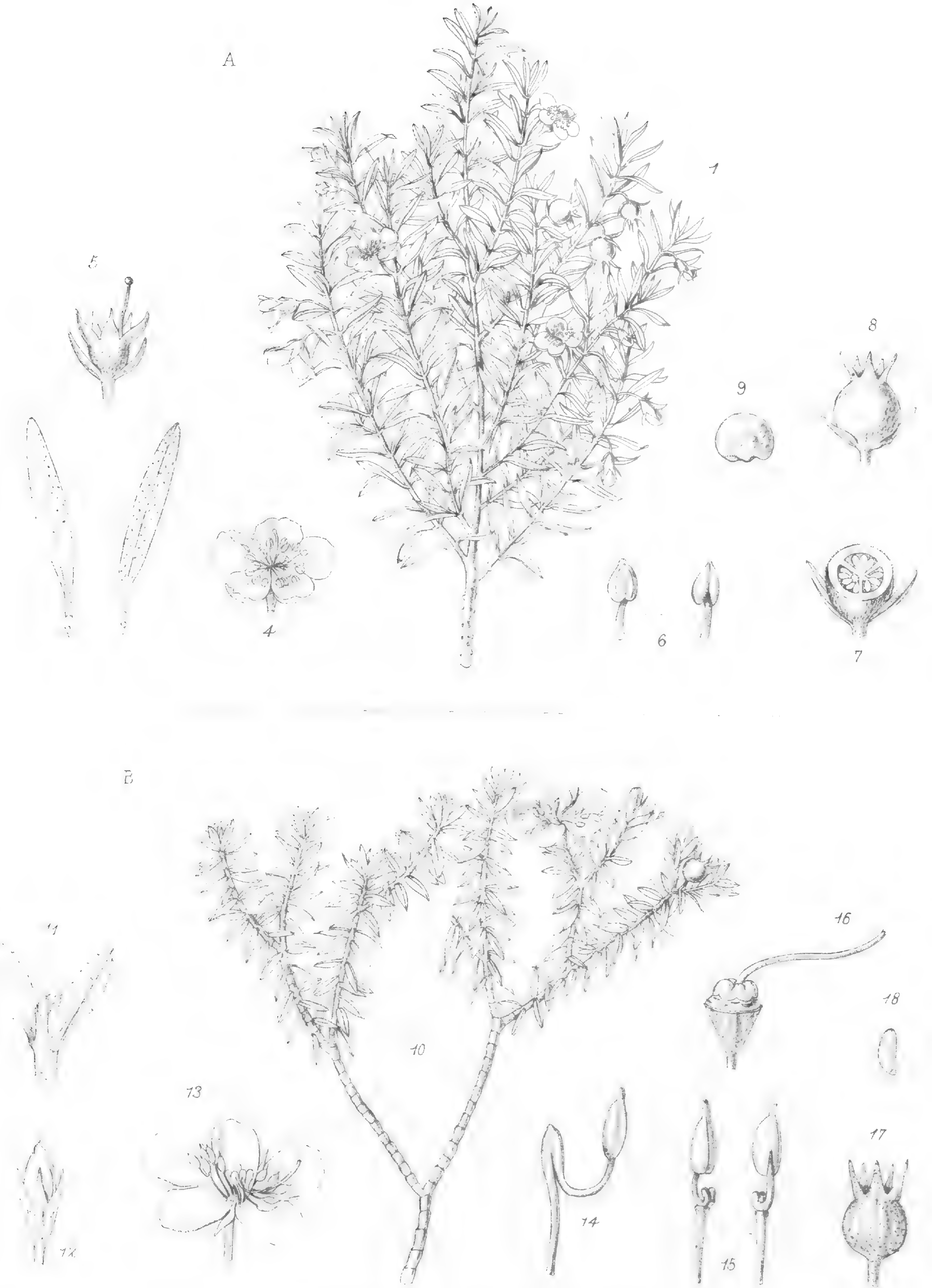
M. Smith del. Crowther lith.

A. 1–8. LEITGEBIA IMTHURNIANA, *Oliver*.
B. 9–17. BONNETIA RORAIMÆ, *Oliver*.

Mintern Bros. imp.

M. Smith del. Morgan lith.

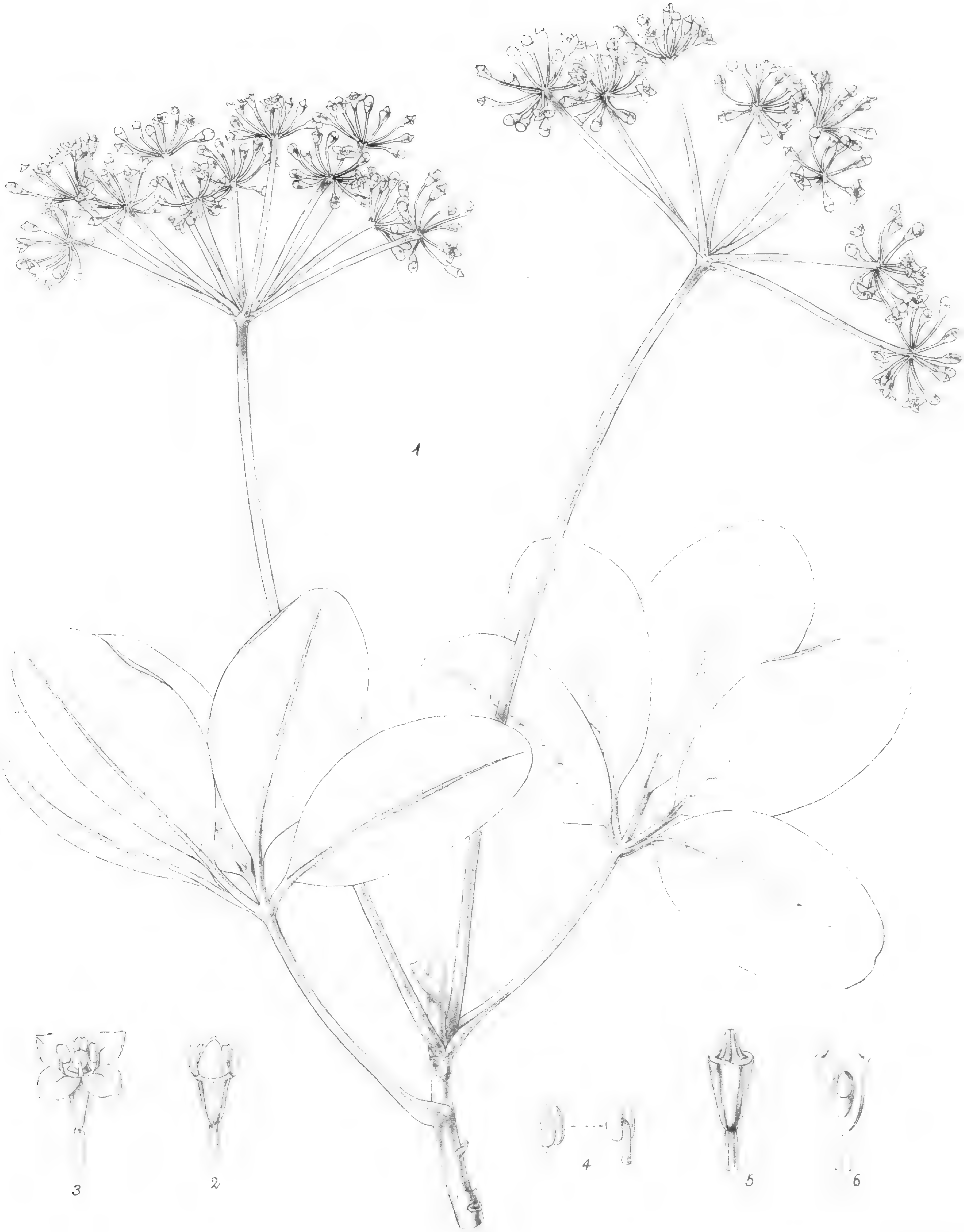
A 1-6 RAVENIA RUELLIOIDES, *Oliver*.
B 7-13 MYRCIA RORAIMÆ, *Oliver*.



M. Smith del. Morgan lith.

A. 1-9 MYRTUS STENOPHYLLA, *Oliver.*
B. 10-18 MICROLICIA BRYANTHOIDES, *Oliver*

J.N. Fitch imp.

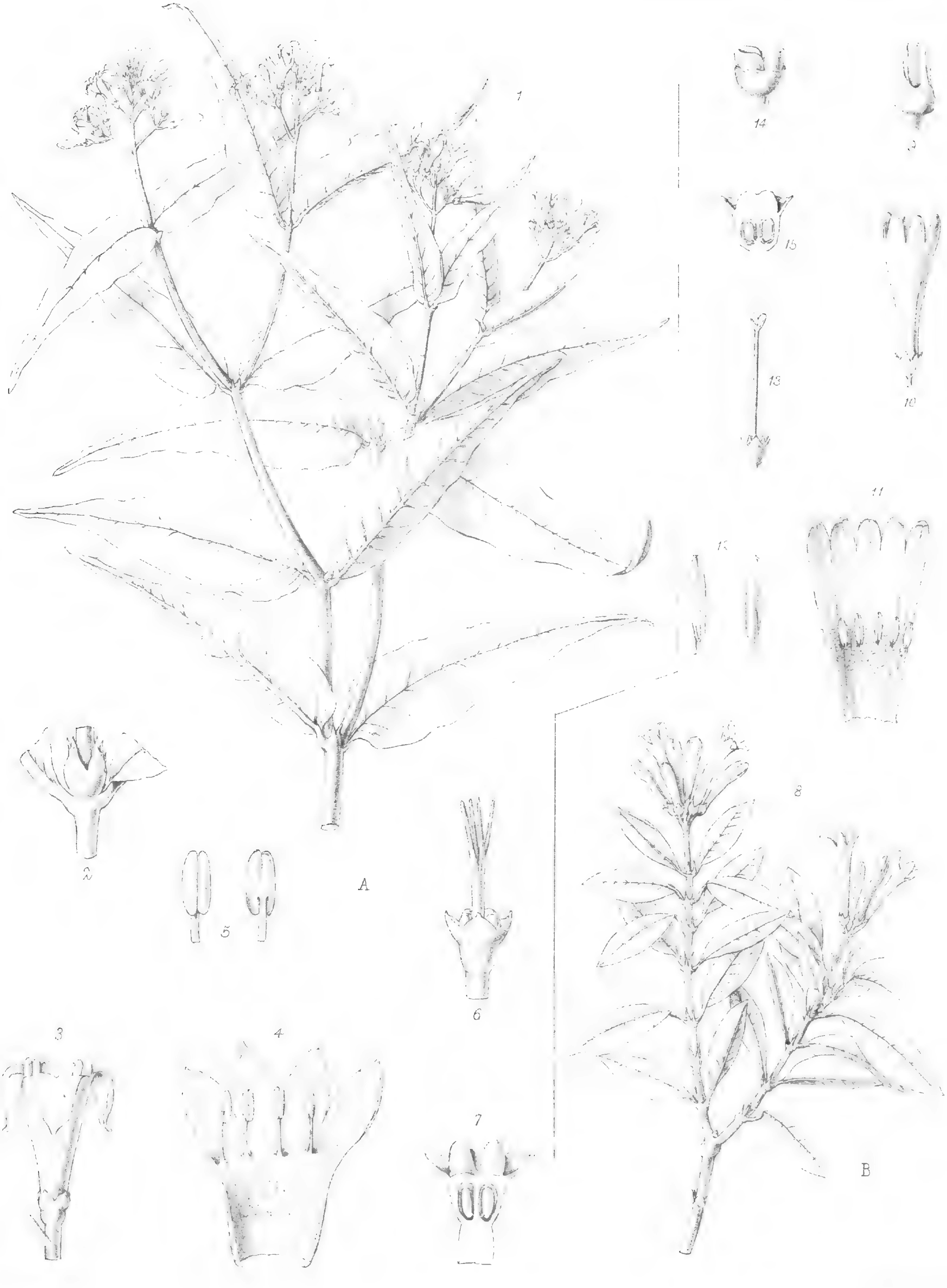


M. Smith del. C. H. Fitch lith.

CREPINELLA GRACILIS, *March.*

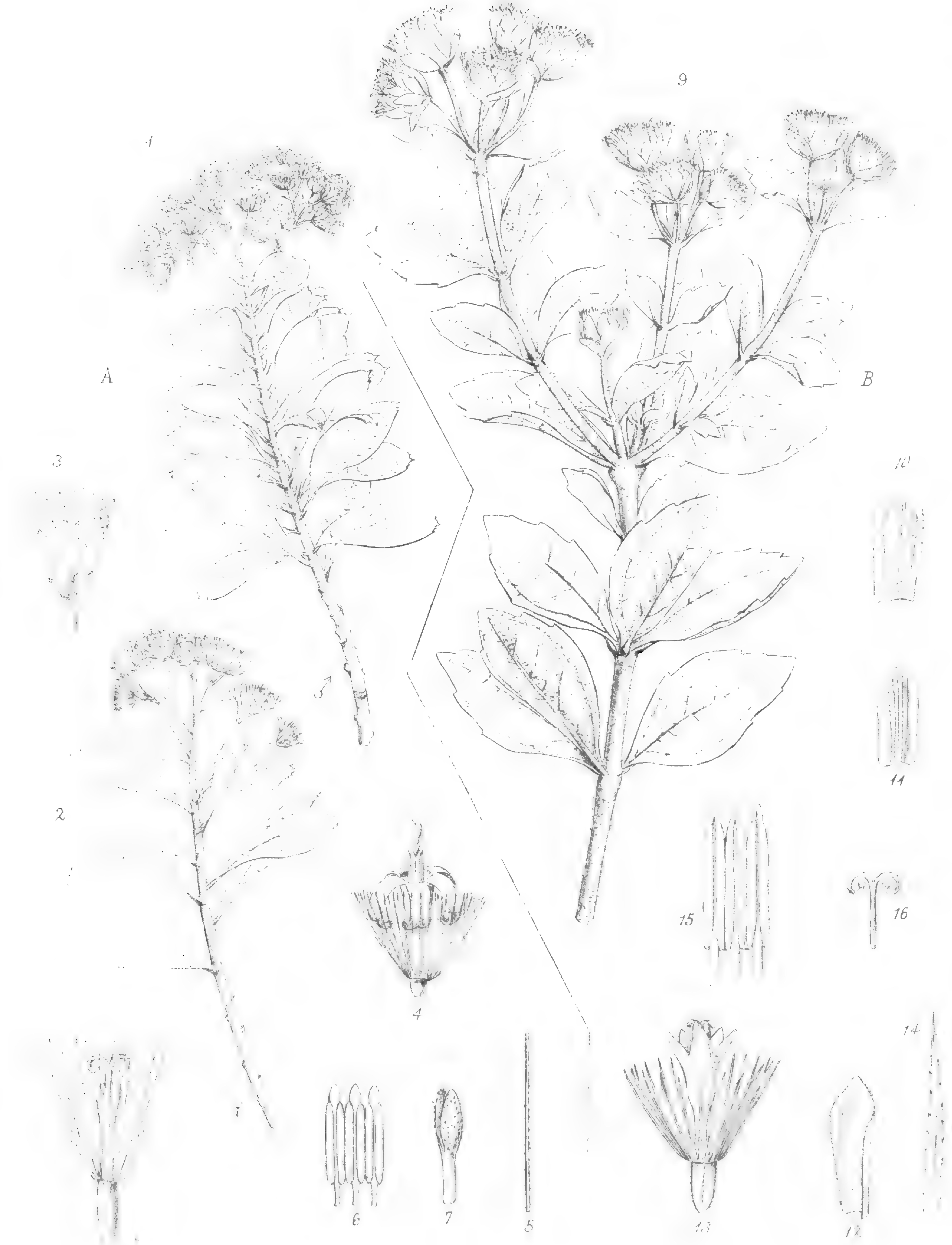
J. N. Fitch imp.

SCIADOPHYLLUM CORIACEUM, *March.*



J. N. Fitch imp.

A. 1-7 PSYCHOTRIA IMTHURNIANA, *Oliv.* B. 8-15 P. CONCINNA, *Oliv.*



M. Smith del.
J. Allen lith.

A. 1-8 BACCHARIS VITIS-IDÆA, *Oliv.* B. 9-16 CALEA TERNIFOLIA, *Oliv.*

imp.

M. Smith del.
Van Iterson lith.

A. 1-6 LEDOTHAMNUS GUYANENSIS. *Meissn.*
B. 7-11 UTRICULARIA CAMPBELLIANUM. *Oliv.*

M. Smith del. G.H Fitch lith.

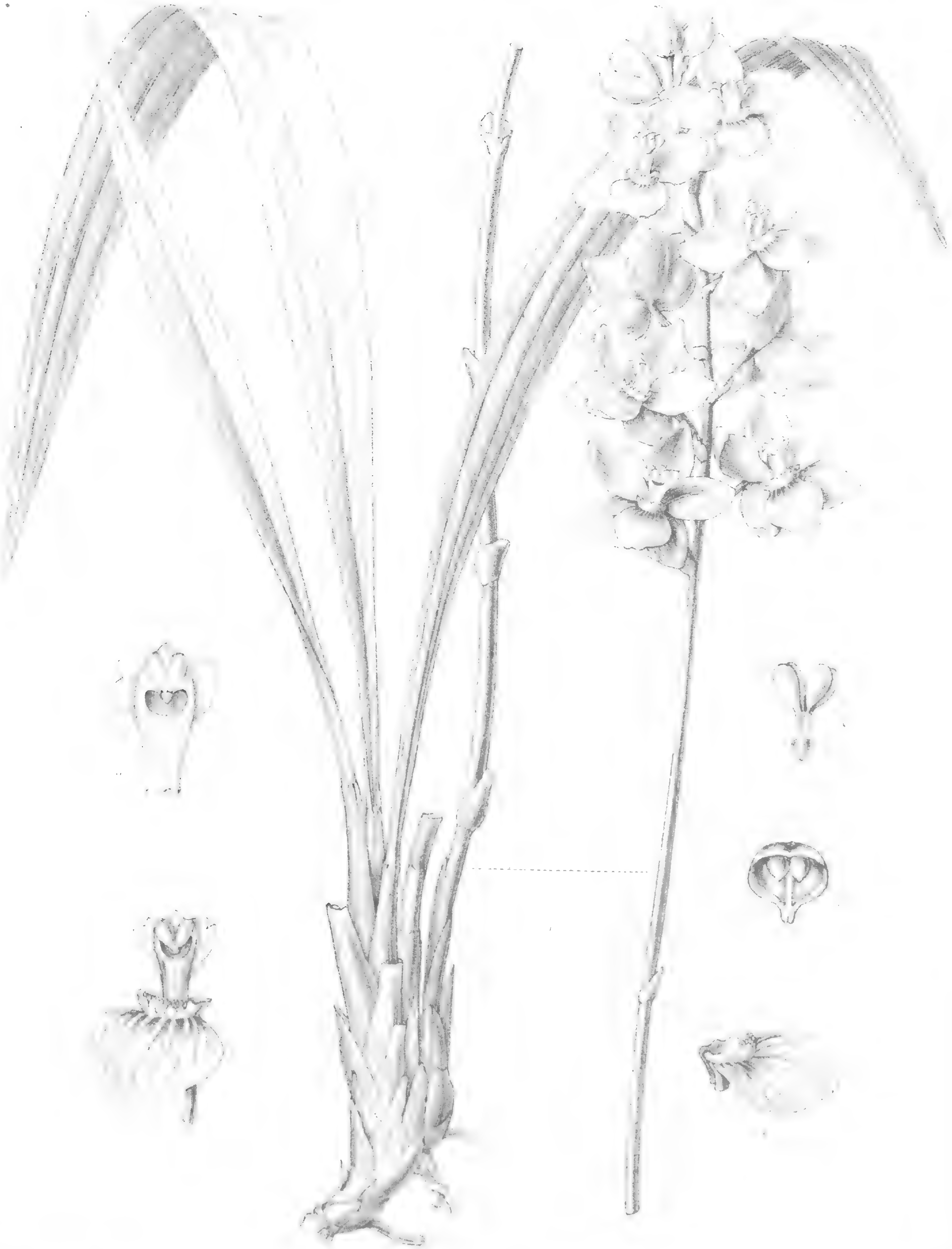
TABEBUIA RORAIMÆ, Oliv.

J.N Fitch imp

M. Smith del. Fitch lith.

A. 1-6 EPIDENDRUM IMTHURNII, *Ridley*. B. 7-10. E. VIOLASCENS, *Ridley*.

J.N. Fitch imp.



ZYGOPETALUM VENUSTUM, Ridley.

Mintern Bros. imp.

M. Smith del. Fitch lith.

A. 1-6 STENOPTERA ADNATA, *Ridley*
B. 7-11 PELEXIA APHYLLA, *Ridley*.

J. N. Fitch imp.

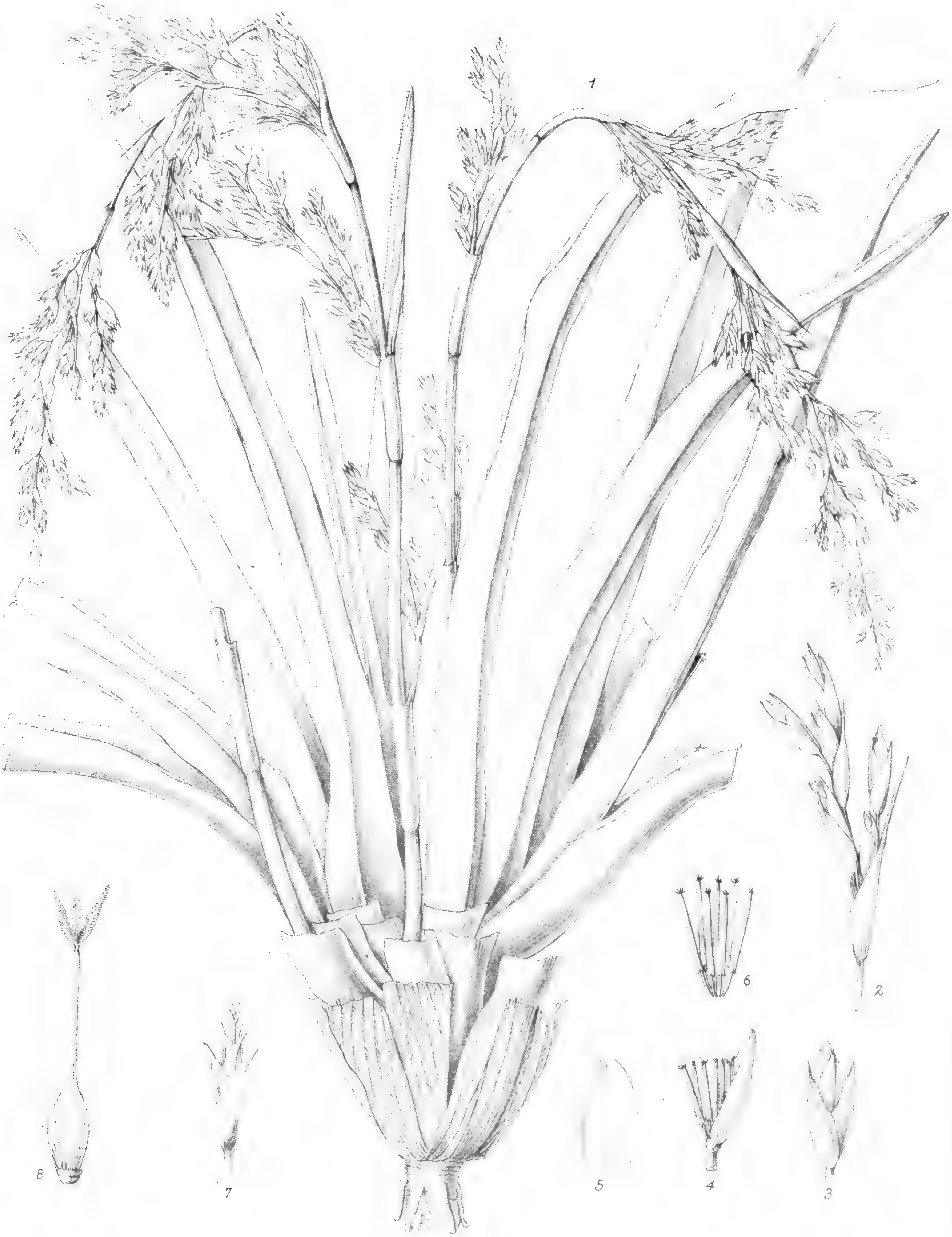
M. Smith del. et lith.

A. 1-6. TOFIELDIA SCHOMBURGKIANA. *Oliv.*
B. 7-14. PÆPALANTHUS RORAIMÆ.

A. 1–4 XYRIS SETIGERA, Oliv. B. 5–8 X. WITSENIOIDES, Oliv.

M. Smith del. Morgan lith.

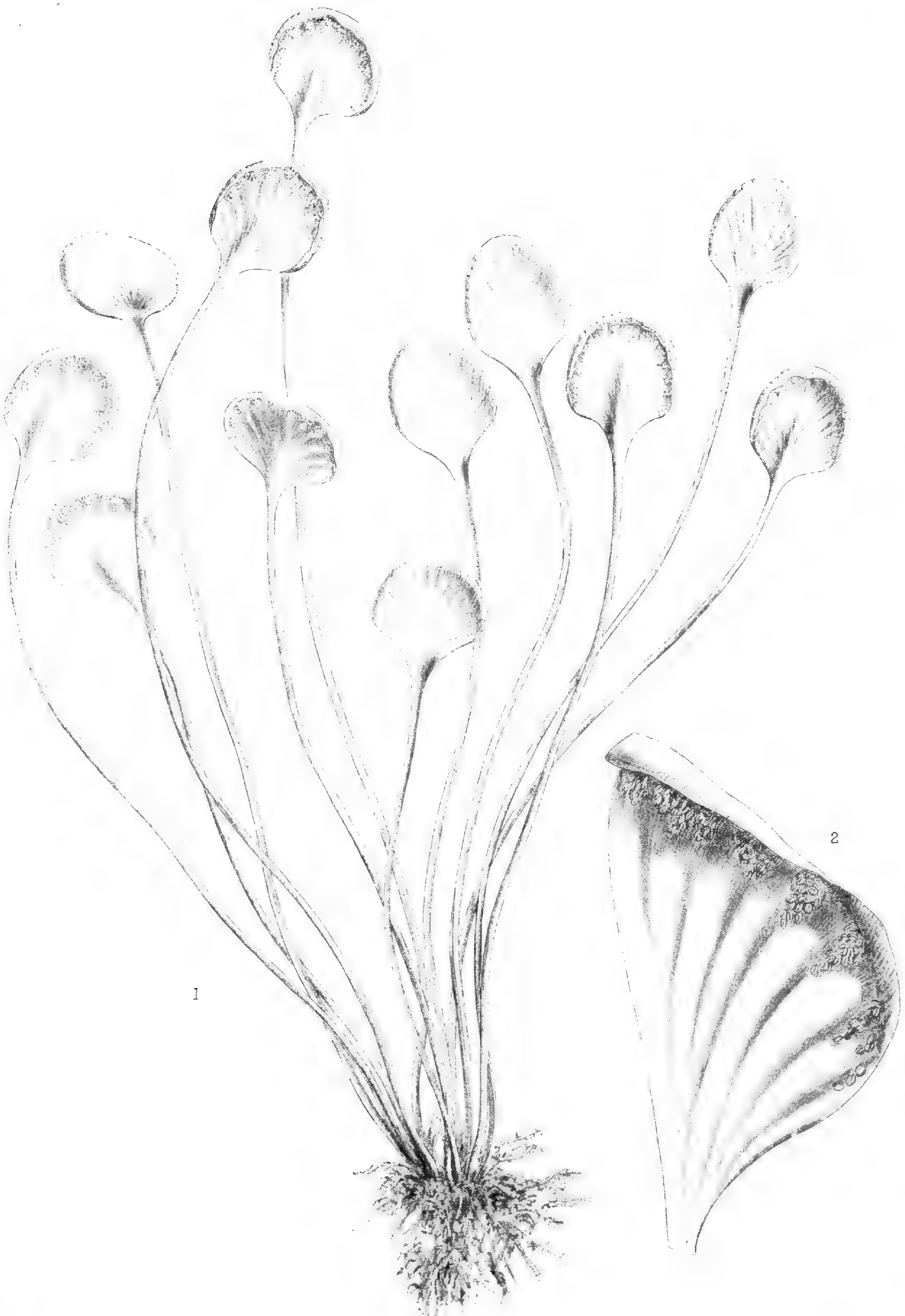
CRYPTANGIUM STELLATUM, *Boeckl.*



M. Smith del. Van Iterson lith.

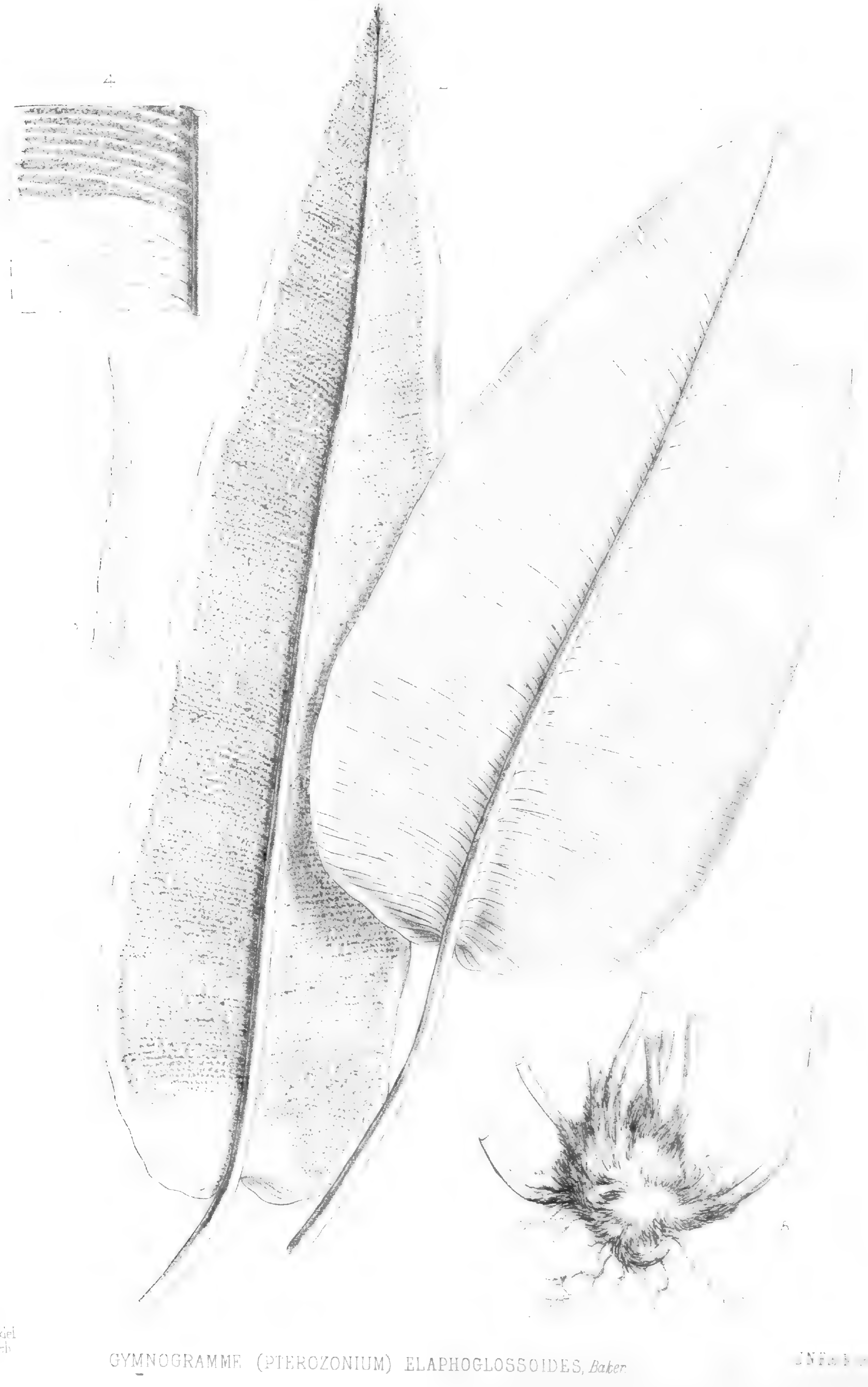
EVERARDIA MONTANA, *Ridley*.

J. N. Fitch imp.



GYMNOGRAMME (PTEROZONIUM) CYCLOPHYLLA, *Baker*

J. N. Fitch imp.

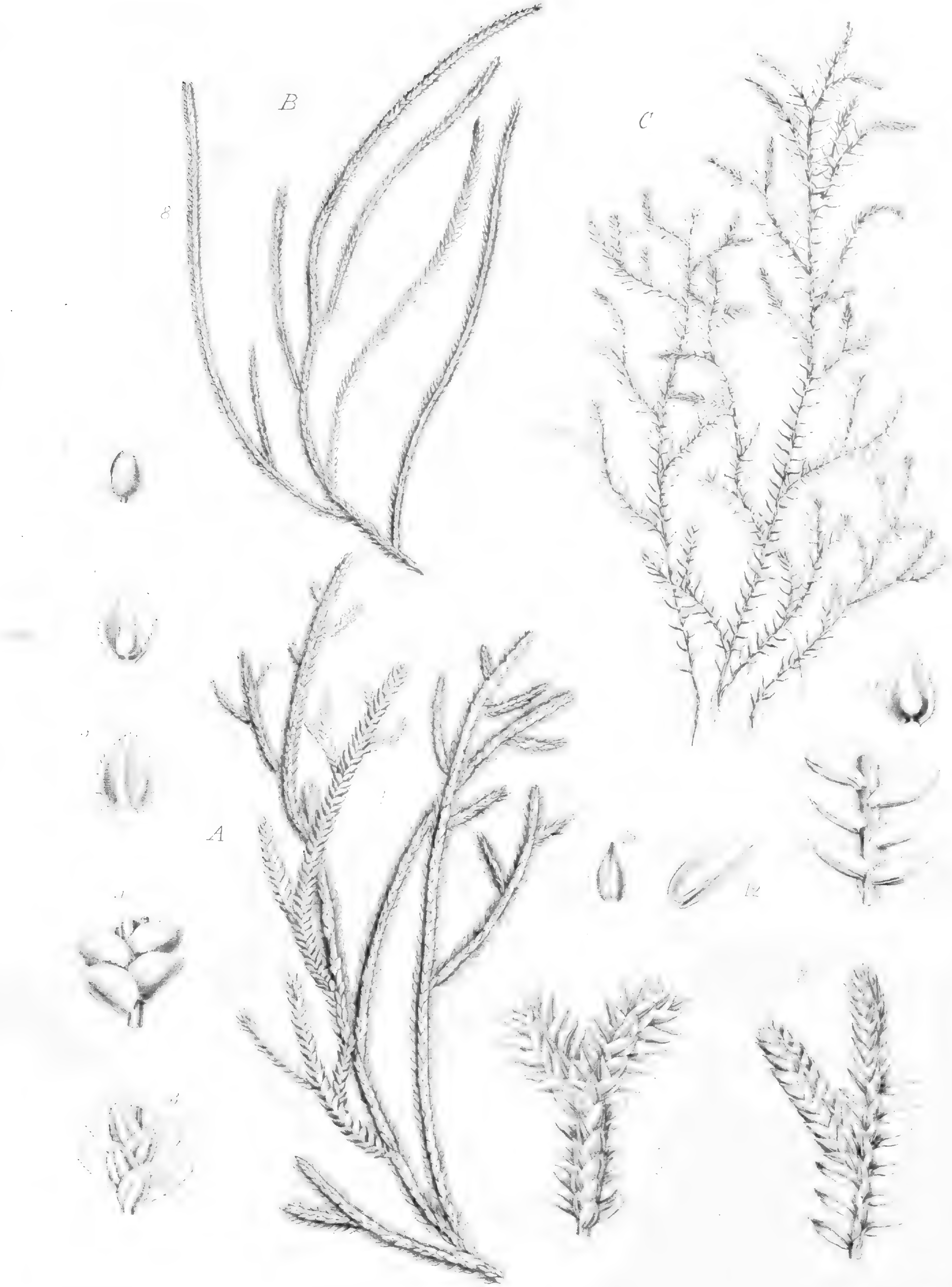


H Baker del
J Allen lith

GYMNOGRAMME (PTEROZONIUM) ELAPHOGLOSSOIDES, *Baker*

H. Baker del.

ENTEROSORA CAMPBELLII, *Baker.*



M. Smith del.

TACHYGYNANI ... Baker

8. S. VERNICOSA, var. OLIGOCLADA. 9-14. S. RORAIMENSIS, Baker

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ON APOSPORY AND ALLIED PHENOMENA.

BY

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XVI. *On Apospory and allied Phenomena.* *By* Prof. F. O. Bower, *F.L.S.*

(Plates LVII.–LIX.)

Read 16th December, 1886.

THE term "spore" has been, and still is, used in so different senses by different writers that it will be necessary, in treating a subject such as the present, to define clearly which of its various senses will be adopted in this paper. The choice lies between two definitions given by two eminent botanists, Sachs and De Bary; the former, in his Textbook *, defines the spore, in a restricted sense, as "either a direct product of fertilization (zygospore, oospore) or the product of a vegetative act induced by fertilization;" that is, starting from the Mosses and Ferns, he applies the term exclusively to those reproductive cells which are *homologous* with the spores of those plants, while to others which are not homologous he applies other terms. De Bary, on the other hand, gives a wider significance to the term, and applies it quite generally to "any cell which, as a single cell, becomes free, and is capable of direct development into a new organism (Bion), without reference to its origin and homology" †. Since, in the description of the phenomena to be detailed below, it is of importance to avoid any confusion of view by the introduction of discussions as to the homology of the various reproductive cells of the Thallophytes with the spores of the Archegoniatæ, the narrower definition of the term, given by Sachs, will be adopted in this paper; but this is done rather with the object of clearing the ground of unwieldy discussion than as any expression of opinion as to the relative merits of the two definitions for purposes of general description. Accordingly, in discussing the phenomena of apospory, it will be understood that those cases only are taken into account in which the homology of the spores with those of the Mosses and Ferns is generally accepted ‡.

It is just ten years since Pringsheim § and Stahl || found, independently of one another, that it is possible, by cultivation under abnormal circumstances, to induce a formation of protonema by direct vegetative growth from the sporogonium of certain Mosses. In such cases there is an excision of the spore from the cycle of life ¶. Writing in 1878,

* 4 Aufl. p. 237.

† Morph. und Biol. der Pilze, 1884, p. 139.

‡ *Cf.* De Bary, Morph. und Biol. der Pilze, pp. 130, 131. Compare also McNab, Proceedings of the Royal Dublin Society, n. s. vol. iv. part 9, p. 466 &c.

§ Monatsb. d. k. Akad. Wiss. zu Berlin, 10 July, 1876; also Jahrb. für wiss. Bot. Bd. xi. 1877, p. 1.

|| Bot. Zeitg. 1876, p. 689.

¶ A peculiar abnormality is mentioned by Masters (Veg. Terat. p. 173). It was recorded as occurring in the Moss *Encamptodon* (*Weissia*) *perichætialis* by Dr. Montagne (Ann. Sci. Nat. 1845, pp. 119 and 366, plate 14). In

Vines * applied to this and similar modes of propagation the term "aposporous," which may be accepted as a useful one †. Further, the term "apospory," corresponding in form to "apogamy," may be adopted as expressing the phenomenon thus artificially induced in the Mosses. It will be well more clearly to define the use of these and other terms at the outset. In the following pages the term "*sporal arrest*" will be applied to all cases where spores do not come to functional maturity; this arrest may be partial or complete. Occasionally this sporal arrest is the only abnormal character; but in the most prominent of the abnormal examples of Ferns about to be described the phenomena are not simply those of arrest. The case is complicated by concomitant abnormalities, especially by a substitution of vegetative growth for the office of the spore. The vegetative growth, thus originating directly from the tissue of the sporophore, may at once assume the internal and external characters of the sporophore; this may be termed "*sporophoric budding*," where from the sporophore a fresh sporophoric bud is directly produced. With this might be compared "*oophoric budding*," a term which it is proposed to apply to those cases where from the oophore fresh individuals, showing oophoric characters, are produced by a vegetative process. Examples of this have been described by Cramer ‡ in the case of the Fern-prothallus, and by Treub § in the prothallus of *Lycopodium*. But the substitutionary growths from the sporophore following sporal arrest do not always assume the characters of the sporophore; they may show either at once or ultimately the characters of the oophore: to such a transition, by a direct vegetative process and without the assistance of spores, from the sporophore to the oophore, the term "*apospory*" is applied. This process may be regarded as the converse of that styled "*apogamy*," which consists essentially in a direct transition from the oophore to the sporophore without the intervention of a sexual process. It is important to note, however, that "sporal arrest" is not necessarily followed by any substitutionary vegetative growth; and cases will be cited of both partial and complete arrest of the spores, which show neither "apospory" nor "sporophoric budding" in the senses above defined; in fact, there is in such cases no substitutionary vegetative development, over and above those vegetative processes found in normal allied plants.

It is obvious that the most typical and prominent cases of the phenomena above defined

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this Moss the capsules were found to contain no spores, but in their place were "gemmæ of a kind analogous to those which are to be found in the cups of *Marchantia*." This was the case with all the capsules opened. The gemmæ were in the form of wedges or parallelograms, and multicellular. As they were not germinated, their real nature cannot be truly stated, but the comparison with the gemmæ of *Marchantia* would suggest a case of formation of oophoric gemmæ, in place of spores.

* Journal of Botany, 1878, p. 355.

† A reference to the preliminary paper on this subject (Journ. Linn. Soc., Bot. vol. xxi. p. 360) will show that though the source of the term "apospory" was not acknowledged, the word was not defined nor introduced as a new one. Compare 'Nature,' vol. xxxi. pp. 151, 216.

‡ "Ueber die geschlechtlose Vermehrung des Farnprothalliums," Denkschr. d. Schweiz. naturforsch. Gesellsch. Bd. xxviii. 1880.

§ Ann. Jard. Bot. de Buitenzorg, vol. v. 1886.

are to be looked for in those plants in which the sexual and sporal modes of reproduction are in the strongest antithesis to one another, that is, in those plants which show most typical alternation of generations. In these the two modes of reproduction are, as regards the individual, most distinctly separate, both in time and space; it is accordingly easier in these to recognize the characteristic features of the phenomenon than in such plants as the Phanerogams, in which the oophore generation is reduced, and the phenomena of sporal and sexual reproduction brought into closer relations one to another.

The observations of Pringsheim and Stahl, above alluded to, have shown that a return from the sporophore to the oophore by a purely vegetative process, and without the intervention of spores (apospory), may be induced in certain Mosses by subjecting them to abnormal conditions. It is the object of the following pages to describe examples of similar phenomena in Ferns, in which group apospory has been till recently unknown. But whereas in the case of the Mosses the results were obtained by subjecting the plants to abnormal conditions, some at least of the examples of Ferns to be described show similar peculiarities even under normal circumstances. The observations on the Ferns will now be described in detail, and the comparison with other similar phenomena, as well as the theoretical discussion of the facts, will be deferred to the close of the paper.

Athyrium Filix-fœmina, var. *clarissima*, Jones.

This plant presents an abnormal mode of development of the sporangium, which has already been the subject of repeated notice *. The specimens upon which the following observations were founded were kindly supplied from plants in the possession of Mr. G. B. Wollaston and Mr. Druery. It is to the latter that the credit is due of having first fully recognized the peculiarity of the mode of propagation of this Fern, of having traced it through, and demonstrated, by cultures shown before the Linnean Society, that the plant produces prothalli without the intervention of spores. The actual plant from which the specimens now living were derived was bought by Colonel Jones from a local fern-collector in North Devon, by whom it had been found growing wild. It is, however, uncertain whether the peculiarities now shown were to be seen in the plant when first found. Col. Jones, who recognized it from the first as a distinct variety, failed in repeated attempts to raise it from spores, and, though he did not subject it to a microscopic examination, he came at last to the conclusion that it produced abortive spores; this result was further confirmed by the experience of Mr. Wollaston, and it may be concluded that, whether the substitutionary growths subsequently found were present or not on the plant in the feral condition, it showed from the first an arrest of the spores. It is unfortunate that certain information is not to be had on this point, so that it might be possible to form an opinion as to the permanency of those peculiarities which the plant shows.

If the sori of this variety of the Lady Fern be examined in August, it will be found that they are, to the naked eye, of almost normal appearance; the indusium is normal,

* C. T. Druery, Gard. Chron. 1883, p. 783; Journ. Linn. Soc., Bot. vol. xxi. pp. 354, 358; F. O. Bower, Journ. Linn. Soc., Bot. vol. xxi. p. 360; Druery, Proc. Bristol Nat. Hist. Soc. vol. iv.

covering numerous small green or brownish sporangia. A microscopic observation of the sporangia will, however, disclose the fact that even at this period the oldest of them have already begun to assume abnormal characters. Transverse sections of a pinnule, so cut as to pass through a sorus, show that, in their early stages of development, the sporangia have that arrangement and succession of cell-divisions which is usual; each is thus seen to be an elongated, club-shaped body, consisting of a massive stalk and a head composed of a single central cell (the archespore), surrounded at first by a single layer of investing cells, which in the normal sporangium give rise to the outer wall and annulus (Plate LVII. figs. 1, 2). In the majority of cases the normal course of development is arrested at this stage, and the peculiarities to be described take their origin by purely vegetative growth from the cells of the young sporangium; in other cases, however, the normal course of development of the sporangium may proceed further; thus in fig. 1 *a* the archespore has again divided as in normal sporangia, so as to form the first cell of the tapetum; again, in other, but rare examples the annulus has been seen almost fully developed, and in one specimen even the spore-mother-cells were observed already separated from one another, and lying freely within the enlarged cavity of the sporangium. This was, however, the most advanced specimen seen, and it may be stated plainly that, in the many observations made on material taken at various periods, *not a single sporangium has been found to produce mature spores.* The plant is, then, so far as experience goes, an example of complete sporal arrest.

We may now proceed to the study of those abnormal developments which appear in this plant, and, as regards the propagation of the variety, take the place of the formation of spores. In all cases observed these consist, in the first place, in the growth and division of the cells of the young arrested sporangia, and of the sporangia only. The tissues thus produced are thin-walled, and even when they form solid masses (as is not unfrequently the case) they exhibit no internal differentiation. The contents of the cells consist of plentiful protoplasm, with numerous chlorophyll granules, which, as development proceeds, elaborate considerable stores of starch (figs. 3, 4). This being the case, they are obviously self-supporting after the first stages are past, and this is clearly shown in cultures which have been grown for a few weeks under a bell-glass on moist soil; in these, though the tissues of the parent frond die and turn brown, even up to the very stalk of the sporangia, the tissues of the latter present a green and healthy appearance.

In some cases the vegetative growth and cell-division extend generally to all tissues of the sporangium; in others it appears more specially localized in different parts of the sporangium, and this difference appears to depend upon the period of development which the sporangium had reached before the substitution of vegetative growth had interfered with the normal course of development. It may be stated, as a general result of very numerous observations, that the earlier the arrest of the normal development the more complete and general is the substitution of the vegetative growth throughout the sporangium; while conversely, in those sporangia in which the normal development has proceeded furthest, either no substitutionary vegetative growth appears, or it is only to be found in the cells composing the stalk of the sporangium. Taking the latter case first, in the specimen shown in fig. 3 the annulus had already been formed, though its cell-walls had not become thickened; here the cells of the head of the sporangium had almost lost their contents, whilst those of the stalk (*st.*) have abundant protoplasm and chlorophyll granules. If any substitutionary growth were assumed at all in so old a sporangium, it would probably be in the stalk; but no instance has been observed of a sporangium, developed so far as to show a clearly marked annulus, assuming a substitutionary vegetative growth. It is therefore concluded that in these sporangia the arrest of the normal development is complete and final.

In other cases, not so far advanced as fig. 3, it has been observed that the whole head of the sporangium is finally arrested, while the substitutionary growth appears in the stalk only (figs. 4, 5). An examination of fig. 4 will show that, though the archespore itself has not divided, the cells forming the wall of the sporangium have undergone more divisions than in such a specimen as fig. 6, while that more advanced development (fig. 4) is followed by the complete arrest of the head of the sporangium; the stalk, however, has assumed active vegetative growth. The same has probably been the case with the specimen shown in fig. 5, though the body (*h*), which is probably the head of the sporangium, is here so shrivelled that the actual cell-divisions in it could not be stated with certainty. In these examples of arrest at a later stage of the normal development it is clear that, since the whole head of the sporangium is aborted, the archespore takes no part in the further growth; this is, however, the case also for the large majority, if not for all, of the sporangia which are arrested at earlier stages. A comparison of the series of figs. (1–7) will show clearly that in all cases where the archespore is distinguishable at all, it preserves its identity without undergoing further divisions; and, indeed, it is very frequently possible to recognize the archespore, as a brown dead cell, in growths of very considerable size produced from early-arrested sporangia. These facts possess some interest, as showing that the cell from which the spores are derived is specifically a spore-forming cell, and is not (at least in the large majority of cases, if not in all) in a position to assume other functions.

Turning now to the description of the substitutionary growth as shown in examples of earlier arrest, it is seen that here the whole head of the sporangium is not aborted and thrown off, but that the superficial cells of it take an active part in the substitutionary vegetative growth. The starting-point will be sporangia such as those represented in fig. 2 B, C. In these the archespore is easily recognized; in some cases the number, form, and arrangement of the cells closely correspond to the normal (A); in others there are recognizable, even at this early period, cell-divisions which are not normal, together with a general elongation of the sporangium and arrest of the archespore. These foreshadow that purely vegetative development which they ultimately assume in place of the normal. Not unfrequently one or more cells of the head of the sporangium assume a brown colour and appear inactive; in other cases, as the results of further culture show, the whole series of superficial cells take part in the development. Thus in fig. 6 all the superficial cells of both stalk and head show active properties, being well supplied with protoplasm and chlorophyll, which, however, are absent from the archespore (*a*). These characters, together with the enlargement of the stalk (*st.*), are still better seen in specimens which have been germinated for some time on damp soil (Plate LVII. fig. 7). Here the archespore may be seen in process of disorganization, while the superficial cells of the head and those of the stalk have increased greatly in size beyond the normal. The elongation of such specimens may be very considerable (figs. 8, 9), the whole being a solid massive body, sometimes of irregular outline (fig. 5), and showing, as regards the form and arrangement of its cells, nothing of a characteristically prothalloid character; but in the thin cellulose walls, plentiful protoplasm and chlorophyll, as well as in the occasional presence of glandular hairs (fig. 10), they resemble typical prothalli. Outgrowths of the sporangia such as these, of an irregularly cylindrical form, and while still attached to the parent frond, may produce antheridia of the normal type (fig. 11). This has been repeatedly observed no such outgrowths while still attached to the decaying pinnule from which they sprung, and the position of the antheridia has been seen, as shown in fig. 11, to be but a few cells removed from tissues which are characteristically those of the sporophore. This massive, irregularly cylindrical type of development was found to be very prevalent in cultures made during the present year (1886), at normal temperatures, but with protection from frost; whereas in cultures made in 1884, in a hothouse at Kew, it was found that the type of development was, as a rule, a more near approach to that of the normal flattened prothallus, and that in those specimens a characteristic apical growth frequently appeared, which was entirely absent from such specimens as those in figs. 10, 11, &c. Thus in fig. 12 is shown an example of an irregular, flattened, lateral growth from the enlarged stalk of a sporangium, the archespore of which is still plainly to be seen. In fig. 13 is shown a further example of an irregular flattened body derived from a sporangium, in which growth with a characteristic apical cell has begun laterally. Further, in fig. 14 (Plate LVIII.) is shown a fair type of the development of a flattened prothallus, as it might be seen in the cultures of 1884, the irregular outgrowth from the sporangium having finally settled down into a flattened form of growth, with wedge-shaped initial cells at more than one point. The result is a flattened prothalloid body approaching to the normal type. As these high-temperature cultures progressed, the approach to the normal form became more and more close; subsequently sexual organs were produced (fig. 15), and finally from them were derived numerous young sporophores. Thus the cultures carried on at Kew have led to the same result as those already recorded by Mr. Druery as having previously been carried on by himself*. Further, on young plants raised from the "pseudo-bulbils" by Mr. Druery the phenomena of sporal arrest can be already seen, accompanied by substitutionary vegetative growth; thus, so far as experience goes at present, the peculiarities of the variety are handed on to the second generation.

The question remains as to the nature of those bodies which Mr. Druery found in 1883 on this Fern, and described and figured in this Society's Journal† under the name of "pseudo-bulbils." They have not recurred in their full development either in his cultures of subsequent years, nor yet in those at Kew. As the result of observation of numerous

* Journ. Linn. Soc., Bot. xxi. pp. 358–360.

† *L. c.* p. 355; also p. 358, fig. 1.

vegetative growths from sporangia in the Kew cultures, and the recognition of the fact that many of them assume a massive, almost ovoid, form, and considerably larger development than those shown in figs. 5, 10, 11, it would appear that Mr. Druery is correct in his suggestion that his pseudo-bulbils are only different in degree, and not in kind, from the other less massive growths from the sorus; in fact, it seems probable that, under certain more favourable circumstances, presumably culture at low temperatures, the plant would produce substitutionary vegetative growths of larger size and more massive structure; these would be the "pseudo-bulbils" of Druery, which might be regarded as reservoirs of nutriment to be ultimately used up in forming the prothalloid growths described by him (*l. c.* p. 359). They may well be compared with those massive growths which will be described below as occurring in *Polystichum angulare*, var. *pulcherrimum*.

From the observations above detailed it is placed beyond doubt that in this variety of Fern there may be a direct transition from the sporophore to the oophore by purely vegetative growth, and without the intervention of spores; to this the term apospory is applied: further, that the oophores thus produced, though they are at first abnormal in form, are still functionally true oophores, that they produce antheridia and archegonia, which are functional, and that the final result is the production of new sporophores similar to the original. Thus in this case the spore-stage may be excluded from the life-cycle. Whether it is permanently excluded, and whether its permanent exclusion is followed by any weakening or other effect on the stock, remains to be seen when repeated cultures have secured numerous repetitions of these singular phenomena.

Polystichum angulare, var. *pulcherrimum*, Padley.

The species *P. angulare* is well known as being an extremely variable one, so that it has long exercised the ingenuity of collectors. Among the very numerous described varieties many are recognized as producing ordinary sporophoric buds on the fronds, and this is made use of, together with other characters, as a distinguishing feature in collecting varieties such as *aristatum*, *proliferum*, *prolif. Footii*, *prolif. Wollastonii*, &c. But apparently all these afford merely repeated examples of one and the same phenomenon, the formation of sporophoric buds on the frond. The peculiarities of the var. *pulcherrimum* are of an entirely different order, and deserve a detailed description.

According to Mr. G. B. Wollaston (Gard. Chron., Dec. 19th, 1885, p. 780) the variety described as *P. angulare*, var. *pulcherrimum*, Padley, was first found by the Rev. C. Padley, more than twenty years ago, in North Devon; and it has been in cultivation since that period, a very fine plant being in the possession of Mr. Wollaston. It was from this specimen that the chief supply of material for this investigation was derived. It might be thought that abnormalities so extraordinary as those to be detailed below are merely isolated and solitary sports; and in this connection it is of great interest to note that similar abnormalities have been observed on plants found recently by Dr. Wills near Chard, in Dorsetshire, a district sufficiently removed from the first-named locality to make a near lineal descent seem improbable. This variety (*P. angulare*, var. *pulcherrimum*, Padley) has already been the subject of previous notices, by Mr. Wollaston *, who has described and figured it, by Mr. Druery †, and by myself ‡.

Over and above the peculiarity of the formation of prothalloid outgrowths from the frond, *P. angulare*, var. *pulcherrimum* differs from the typical *P. angulare* in two points—first, in the contour of the pinnule, the segments on the upper or acroscopic side of the midrib being normal, while those on the lower side are flabellulate, elongated and narrow, and curved upwards (compare Mr. Wollaston's figures); secondly, on the specimens which have come under observation I have never seen a mature sporangium with spores; on fronds which produce sori in the normal position, with a normal indusium, an examination of the sporangia discloses the fact that their development has been arrested (Plate LIX. figs. 32–36). The arrest is, in some cases, at a period when the sporangium consisted of but a few cells; in other, but comparatively rare, examples it is subsequent to the formation of the annulus; but in no case have they been seen to contain spores even approaching to the mature condition. These being the results of examination of a very considerable number of sporangia, it may with safety be concluded that at least the specimens observed were examples of *complete sporal arrest*; and, further, that the prothalloid growths to be described below do not owe their origin to spores. This conclusion is amply justified by anatomical investigations, which point distinctly to their origin by direct vegetative out-growth from the sporophore.

It has been found, however, that though the prothalloid developments thus originate by direct vegetative outgrowth from the sporophore, there is in this plant considerable variety in the details of the process. According to the mode of their origin, at least four types of prothalloid development may be recognized and described. These may be ranged under two main heads, according as they arise:—(I.) entirely separate from the sori, or (II.) in connection with a sorus. We may consider first those which fall under the former head, viz. those in which the prothalloid outgrowths arise at points quite apart from the sori. Such developments may even be found *on fronds which bear no sori at all*, and this was conspicuously the case in specimens supplied by Mr. Druery from a plant from Chard. This formation of prothalli from the frond, and apart from the sorus, appears at or near the extreme apex of the pinnule, or one of the smaller segments of it, and there may accordingly be distinguished two subtypes, which may be named (A) and (B). As (A) may be recognized that in which the development is from the extreme apex of a pinnule or of one of its segments, and the result is in the first instance a thin flattened expansion (figs. 19, 21); type (B) originates from the surface of the pinnule at a point opposite the ending of one of the nerves; the result is in this case a massive cylindrical structure, easily distinguishable from that of type (A) (figs. 27–29).

Taking first type (A), in which the prothallus originates directly from the apex of the pinnule, or a segment of it, it is found that the normal structure of the apex is as represented in fig. 17, the cell-walls being relatively thick and often sinuous in outline. In those cases where a prothalloid development is beginning to form (such as may be found

* Gard. Chron. 1885, p. 780. See plate, p. 781.

† Proc. Brit. Nat. Hist. Soc. vol. iv. p. 3 (1884–85).

‡ Journ. Linn. Soc., Bot. vol. xxi. p. 360, plates xi. & xii.

in material taken in August), the extreme apex consists of cells with relatively thin walls and more abundant protoplasm, and they show signs of repeated division. It was not possible, however, to refer the development in its origin to any one individual cell, nor in early stages of development was any single initial cell to be noted; the growth appears rather to be a general one, distributed over a considerable and not definitely limited area of the apex of the pinnule. The whole process is carried on in a region above the extreme ending of the vascular bundle, which accordingly takes no part in the development of the type (A) (Plate LVIII. figs. 18–20). Until it attains a considerable size, the prothalloid outgrowth thus formed remains as a flattened expansion, only one layer of cells in thickness; but, subsequently, a "cushion," or more massive region, is formed as in a normal prothallus, and on it archegonia are produced. Antheridia are also present in some cases, though apparently not in all (fig. 21). During this development the tips of the pinnules, as well as the prothalloid outgrowths themselves, assume the most complicated curvatures, so that it is often difficult to observe the details under the microscope without more or less injury to the object. It will be recognized that this type (A) of development of the prothallus from the apex of the pinnule, or of one of its segments, was the only one hitherto described by myself and others as occurring in *Polystichum angulare*, var. *pulcherrimum*; also that it more nearly follows the course of normal development of a prothallus from the spore than the type (B) now to be described, since a flat expansion is formed first in type (A), the more bulky "cushion" only appearing subsequently.

As above stated, the type (B) differs from (A) in its mode of origin, the prothalloid growths being derived from the surface of the pinnule, not from its apex. Moreover, from the first, these prothalloid growths are of a massive character, and often assume very peculiar forms. In the material taken in August cases were to be found similar to that represented in fig. 22, where a slight hemispherical swelling was to be seen on the surface of the pinnule, immediately above the ending of one of the nerves (*vb.*). On cutting sections through such specimens, it is clear that the swelling is due to outgrowth of the superficial tissues at a point removed from the apex of the pinnule, that the outgrowth is at first of a purely parenchymatous nature, and that, at first at all events, the vascular bundle takes little or no part in the formation (fig. 23). It appears that the outgrowths may arise either on the upper or the lower surface of the pinnule. As they grow older they assume an elongated cylindrical or obconical form, maintaining throughout their massive character. An investigation of their structure by means of sections shows that, in some cases at least, the vascular bundle is continued with a reduced structure for a short distance into the prothalloid outgrowth (Plate LIX. fig. 24), though it soon dies out. A transverse section at a short distance above the point of insertion on the pinnule accordingly shows a simple undifferentiated character of the tissues (fig. 25). A peculiarity of internal structure is to be noted in sections, either transverse or longitudinal, at points near the apex; these show the presence of heterocysts (fig. 26), usually surrounded by a comparatively small-celled epithelium. Having assumed a massive, elongated obconical form, and often very contorted (figs. 27–29), these growths of the type (B) put out numerous rhizoids, similar to those of a normal prothallus, while, occasionally, irregular massive outgrowths appear laterally as in fig. 29. The extreme apex is always convex, and, even when the more mature part is an almost perfect cylinder, the apical cone itself is flattened. Investigation of its structure has not disclosed the presence of any single initial cell; the arrangement is rather similar to that of a normal thallus after the first stages of development are past, the apical growth being conducted by a series of marginal initial cells. Comparing these prothalloid growths, such as in fig. 27, with normal prothalli, they might perhaps be described as consisting of a massive cushion, without any development of wings. This conclusion is further borne out by the distribution of sexual organs upon them. Antheridia have not been observed on any specimen of the type (B); on the other hand, archegonia are constantly present in large numbers, and that not only on the side which happens to be directed downwards, but almost in uniform distribution all round. The archegonia themselves are to be found in all stages of development, up to the period of decay; but as yet, on the cultures at Kew, no embryo plants have been observed. Subsequently to the appearance of the archegonia, the apical cone assumes a different character of development. Lateral wings are formed, and a flattened expansion is the result, with glandular marginal hairs and other characteristics of a normal prothallus; but even on this, antheridia have not yet been found. An examination of numerous prothalloid growths of the type (B) leads to the conclusion that they produce exclusively female organs.

Though the types above described as (A) and (B) differ in their origin, in their external form, and also in their sexual characters, neither type is exclusively to be found on any one frond, pinna, or pinnule; it appears rather that any pinnule or segment of a pinnule may assume either one or the other of these types of development. Further, an instance has been observed of both types of development being assumed by the same segment of a pinnule: this has been represented in fig. 30, where it will be recognized that not only has the extreme apex of the pinnule grown out into a flattened expansion (*prth. A*), but there is also a massive outgrowth from the surface resembling in position and other characters a prothalloid growth of the type (B) (*prth. B*).

Turning now to those prothalloid growths which arise in connection with the sorus, and accordingly fall under our second head, it may be noted that the discovery of these is entirely subsequent to the publication of the preliminary notice in the Journ. Linn. Soc., Bot. vol. xxi. In the specimens received from Mr. Wollaston in August 1886, though the sori were composed of arrested sporangia, covered by a normal indusium, no further peculiarities were to be noted. Cultivation on moist soil for two or three months, at the normal temperature, but with sufficient protection from frost, resulted in the formation of prothalloid structures in connection with the sori themselves, and quite distinct from the outgrowths from the tips of the pinnules as above described; further, an examination of the figures (31–36) will suffice to show that these outgrowths are of vegetative origin, and do not arise from the germination of spores.

Under this second head two types of development may be recognized, though they merge into one another: type (C), in which the origin of the prothalloid growth is from the arrested sporangium, and type (D), in which the outgrowth is derived from the massive base of the sorus, or even in some cases apparently from the indusium. The microscopic examination of preparations of sori, after cultivation for two or three months, shows that in many cases the arrested sporangia, the indusium, and even the swollen base of the sorus have turned brown, and are in process of decay; in others, however, green, actively living masses of tissue, often exhibiting a true prothalloid form, and bearing sexual organs, are to be found. Taking first the type (C), where the sporangium itself is the starting-point, there may occasionally be found single sporangia, among those already decaying, which retain active vegetative characters, and in which may still be recognized traces of those characteristic cell-divisions which are found in young stages of the normal sporangium; they are, however, masked by the repeated and less regular divisions accompanying the more active vegetative growth (fig. 31). These may be compared with arrested and vegetatively developed sporangia in *Athyrium F.-f. clarissima* (figs. 1–12), the similarity between them being very great. Such specimens illustrate the early stages of development of the type (C), which accordingly corresponds to that example of aposporous development which is found in *Athyrium F.-f.* var. *clarissima* On such outgrowths from the arrested sporangium, antheridia may be found at a comparatively early stage, and even before the outgrowth has assumed a truly prothalloid character. Thus in the specimen fig. 32 the apex of the outgrowth has developed directly as an antheridium, while a second antheridium is in course of formation in a lateral position; this, it will be observed, is a very near approach to the formation of an antheridium actually upon the sporangium itself. Other examples are to be found in which the prothalloid outgrowth appears to be formed laterally from the stalk of the sporangium, while the actual head of the sporangium does not take a direct part: thus, in the section shown in fig. 33 this is the case, though it might perhaps be regarded as an intermediate form leading to the type (D), where the prothallus originates from the base of the sorus; in this example the apical part of the outgrowth had assumed distinctly the prothalloid flattened character, but the basal portion was massive, and produced rhizoids and antheridia, one of the latter being represented in fig. 33 in a position but a few cells removed from the tissues of the typical sporophore. The specimen fig. 35 may also be regarded as an intermediate between types (C) and (D), while that in fig. 34 seems to be clearly a case of outgrowth from the base of the sorus. Among other examples of the fourth type (D), one of the most prominent is shown in fig. 36, in which the initial activity is evidently in the base of the sorus: this consists of a mass of vegetatively active tissue from which rhizoids are formed, while laterally has been formed an elongated filament, bearing lateral rhizoids, and near its apex a flattened lateral expansion, which is already developing as a prothalloid structure. As far as the cultures have gone at present (Nov. 17, 1886), no archegonia have been found on prothalloid outgrowths from the sorus; but, since antheridia so frequently precede the archegonia on the prothalli of Ferns, it by no means follows from this observation that they are throughout exclusively male. Lastly, it may be stated that in some cases single cells, or groups of cells, of the indusium retain their active properties, while the rest die; these cells, with abundant chlorophyll in them, have been observed to put out processes in which repeated cell-divisions take place; but whether these may actually assume prothalloid characters and bear sexual organs, it is impossible at present to state.

It has been noticed by various observers and figured by Mr. Wollaston *, that the prothalli thus produced in a vegetative manner from the frond of this Fern show proliferation in a high degree, so that continuous series of prothalloid growths, derived successively from one another, may be seen still connected together. This has also been noted in various other Ferns, and is, indeed, not an uncommon condition †. Whether it has any special significance in the present case is not clear; but it is worthy of note that it is found to occur in a conspicuous degree in this variety, which shows such a remarkable tendency to other modes of proliferous growth.

From the facts above stated, it is clear that in *Polystichum angulare*, var. *pulcherrimum*, not only may the oophore generation be derived by direct vegetative outgrowth from the sporophore, but further that this phenomenon makes its appearance in various ways, being by no means tied down to one strict type. It will be remembered that in the case of *Athyrium F.-f.* var. *clarissima*, the prothalli originate only from the sporangia; here, as regards their point of origin, no less than four types may be distinguished: these may be tabulated thus:—

I. The prothalloid outgrowths originate at or near the tip of the pinnule or segment of the pinnule.	A. From the extreme apex (figs. 18–21). B. As outgrowths from the surface of the pinnule (figs. 22–30).
II. The prothalloid outgrowths originate in connection with the sorus.	C. From arrested sporangia (figs. 30–32). D. From the base of the sorus (figs. 34, 35).

The two examples above described are cases of true "*apospory*," and in both cases, so far as observation extended, the varieties showed a *complete sporal arrest*. A complete or partial arrest of spore-formation may also be recognized in other Ferns, as associated with substitutionary vegetative growth; but whereas in the former examples these substitutionary growths assumed the characters of the oophore (apospory), in those which will now be described they assume the characters of the sporophore, and may accordingly be placed under the head of "*sporophoric budding*," as above defined. But while recognizing the affinity of these growths to those buds which are commonly found on the fronds of Ferns (*e. g. Asplenium bulbiferum*), it must not be forgotten that in respect of the sporal arrest these cases are to be associated with those of true apospory.

Athyrium Filix-fœmina, var. *plumosum*.

Mr. Druery has already studied and described the formation of sporophoric buds in connection with the sorus in two subvarieties of the above variety, described under the names of *elegans* and *divaricatum* ‡, and there is little to be added to what he has written; still it will be well to put together the results of his observations, and of those

* Gard. Chron. 1885, p. 781. † See Goebel, Bot. Zeit. 1887, p. 681, &c.

‡ Gard. Chron. vol. xx. p. 783; Journ. Linn. Soc., Bot. xxi. p. 354, &c.

made at Kew from material supplied by him, and thus to suggest a comparison of these peculiar modes of development with those above detailed.

Taking first the subvariety *elegans*, the specimen showed that the sorus is, as in var. *plumosum* generally, without a normal indusium; before culture on damp soil, it already showed signs of abnormal development. The swollen base of the sorus was of considerable size and bore sporangia in various stages of development: some of these had a mature annulus and contained spores. That these spores, in some cases at least, attain maturity is indicated by the fact that prothallia not of vegetative origin were occasionally found about the sori, after cultivation on damp soil. Thus this subvariety cannot be regarded as an example of complete sporal arrest, but that it is a case of *partial arrest* is shown by the fact that the large majority of sporangia do not attain the condition of producing mature spores. Over and above this, the chief peculiarity consists in the outgrowth of irregular processes from the base of the sorus (Plate LIX. figs. 37, 38). These were present in small size in the specimens before cultivation, but increased in number and size after germination on damp soil: the frond was placed with its lower surface uppermost on soil in a pot; presently young frond-like organs became clearly visible to the naked eye, growing vertically upwards, without any circinate curvature: their form was very variable, being sometimes simply conical and tapering to a fine point; sometimes they were variously branched (fig. 39) in a manner similar to that seen in the fronds of young Ferns, which they also resembled in their general structure. At first no clearly marked axis or apex of a stem was to be seen; this appears to originate later. There is no question of intervention of a prothallus in this case, as is clearly shown by sections (fig. 40), which demonstrate that the tissues of the young frond are severally continuous with those of the base of the sorus, and through it with those of the original frond.

The other subvariety, named *divaricatum*, shows in the main similar characters to those of *elegans*; there is no indusium, the sporangia are in most cases arrested, but are not unfrequently developed so as to form an annulus and sometimes spores. Irregular outgrowths appear as before, usually in a lateral position below the insertion of the sporangia (fig. 41). Sooner or later the apex of the axis is formed, with young leaves, covered with brown scales and glandular hairs; sections show, as before, a continuity of the vascular and other tissues of the outgrowths with those of the parent frond. We have thus, in these two Ferns, examples of partial sporal arrest followed by sporophoric budding.

No doubt a search through the more aberrant forms of the more variable Ferns would bring to light other examples of the formation of abnormal growths in connection with the sorus, and often associated with a partial or complete arrest of spore-formation; only one further case will be mentioned here, viz. that of a monstrous variety of the Japanese Fern *Aspidium* (§ *Lastræa*) *erythrosorum*, Eat., var. *monstrosum* vel *prolificum*. Here a vegetative bud arises in connection with the basal sorus of the larger pinnæ or pinnules. The sporangia of that sorus develop normally and form mature spores; whether they will germinate or not I am not able to state. The sori in question lie on the acroscopic side of the midrib, and the bud arises on the side of the sorus nearest to the margin; as it develops, the leaves which are formed curl round the margin, and in older stages it appears as though the buds were seated on the upper surface of the frond; this is, however, not really the case (fig. 42). By means of such a case as this, we see that the formation of sporophoric buds from the sorus is not necessarily associated with sporal arrest, and we may regard this as indicating a graduation towards those common and well-known cases of formation of sporophoric buds at various points on the fronds of Ferns quite remote from the sori.

Conclusion.

Maintaining the use of the term "spore" in its narrower sense, as defined by Sachs, we may now proceed to review the facts above detailed, and to place them in relation with others already familiar to botanists; it may, however, be again remarked, in passing, that the adoption of this narrower definition excludes from discussion the large majority of Thallophytes, since in most cases the homologies of their asexual reproductive organs are not clear; it is not the object of this paper to enter upon a general discussion of the homologies of the asexual reproductive organs of the Thallophytes, which would only confuse and overshadow the points before us. Accordingly the application of the comparison to the Thallophytes will be, with but one exception, completely omitted *.

It will be well to take first into consideration the partial or complete arrest of development of the spores themselves, and their consequent loss of reproductive function: it will be remembered that to this the term "sporal arrest" was applied, while it was pointed out that this may occur irrespective of the presence or absence of those substitutionary vegetative growths which so often accompany it. In the case of the Fern first described (*Athyrium F.-f.*, var. *clarissima*) it has been shown that in the large majority of cases the development of the spores does not proceed beyond the appearance of the archespore, though in some instances divisions appeared in this cell in the normal manner; but though the formation of an annulus has been noted more than once, and though in one case even spore-mother-cells were seen, no mature spores have been found to be produced by this plant; it is, then, an example of complete sporal arrest. Passing to *Polystichum angulare*, var. *pulcherrimum*, the case is here very similar, the development of the sporangia being arrested before the production of mature spores; thus this Fern is also an example of complete sporal arrest. Of the remaining three cases above described, not one shows a complete arrest, spores which are apparently mature having been found in each; still, in the subvarieties of *Athyrium* at least, a large proportion of the sporangia are arrested in their development, and it is only the minority which appear to attain maturity. Comparing these facts with others already well known, we learn that sporal arrest is a wide-spread, though never a very common-place phenomenon. As examples, the following may be cited: the case of *Equisetum litorale*, Kuehlewein, described in detail by Milde†; in this plant, which, it is suggested, may be a hybrid, on

* Compare McNab, Scientif. Proc. Roy. Soc. Dublin, iv. (1885) pp. 451–454 and 466–469.

† Monographia Equisetorum. Dresden, 1865.

account of this sporal arrest, it is found that the cells composing the walls of the sporangia are without spiral thickening, and that the sporangia remain permanently closed; further, that the spores themselves, which appear colourless and transparent in the sporangia, are about one fifth to one tenth the size of the normal spores, while the elaters are entirely absent*; this arrrest is, however, not quite constant, since in specimens of the plant from Lapland normal spores with elaters were not uncommonly to be found; these observations have been made over a period of 20 years, and on material from many localities; thus the phenomenon is of some constancy. No attempts to germinate the spores are on record; writers on the subject appear to assume that germination does not take place. While regarding this as a case of sporal arrest, it is to be remembered that the *Equiseta* are well adapted to vegetative propagation, though in *E. litorale* there is but occasionally a very slight unusual adaptation for this, to compensate for the apparent loss of function of the spores. Thus *E. litorale* appears to be an example of sporal arrest, pure and simple, and often without any substitutionary growth.

The case of the homosporous Lycopodiaceæ might also be mentioned: though the spores appear normally developed, the difficulty of germinating them is well known, and Treub † has recently expressed the opinion that the formation of prothalli directly from the spores is the exception rather than the rule; thus, though this can hardly be included under "sporal arrest," the function of the spore seems rarely to be fulfilled, and biologically the result is very similar to that in *E. litorale*.

Among the *Sphagna* are to be found examples of what may be termed a "partial arrest." W. P. Schimper ‡ describes and figures two kinds of spores as occurring either together in the same or in different capsules; the larger ones (Makrosporen) are capable of germination; the smaller, resulting apparently from the division of the mother-cells into 16 instead of 2 cells, have a diameter about one third that of the larger ones; and it is stated that they do not germinate (*l. c.* p. 11). Though the existence of these smaller spores has recently been confirmed, this statement as to their lacking the power of germination has been neither confirmed nor contradicted §. If they be really functionless, we have, in those cases where they occur in special capsules, a complete arrest as regards those individual plants ||; where they occur together with the large spores we may recognize this as partial arrest, a phenomenon which is of frequent occurrence in Heterosporous plants.

Passing now to the plants last named, in the formation of the microspores the full number of those initiated come, under normal circumstances, to maturity; in the case of the macrospores, however, the full development of the few is at the expense of the many; a greater or less number of the spores initiated are usually arrested at an early stage, and do not come to functional maturity; it will be sufficient to cite such well-known

* *L. c.* Taf. xviii. fig. 24.

† Ann. Jard. Bot. Buitenzorg, vol. v. p. 88.

‡ Entwickelungsgeschichte der Torfmoose, 1858, p. 31, Taf. xi. figs. 16–20.

§ Warnstorf, 'Hedwigia,' 1886, p. 89.

|| Warnstorf states (*l. c.* p. 91) that the small capsules most frequently occur on special plants.

examples as the Rhizocarps and *Selaginella*, and among the Phanerogams conspicuous cases such as *Gnetum** and *Rosa livida* †.

If we apply the definition of "sporal arrest" with strictness to the Phanerogams, then there would be included a host of teratological forms, which show, not only arrest of spore-formation, but also substitutionary growths, which are apt to mask the actual phenomena of arrest. It is unnecessary now to enter upon the detailed discussion of these, though they should be remembered in connection with the cases above noted. From what has now been said it will be seen that sporal arrest, whether partial or complete, is a wide-spread phenomenon, and is to be found in one form or another among plants ranging from the Mosses to the Dicotyledons.

We may now proceed to consider the nature of those substitutionary growths which frequently follow "sporal arrest;" and often may, in one way or another, supply the place of spore-formation, as regards the propagation of the plant. But, as above pointed out, the appearance of substitutionary growths does not seem to be a necessary consequence of the arrest of spore-formation; still it is found to occur in a large number of cases, and the two phenomena are no doubt closely related to one another. When the arrest of one member of a system is followed by the excessive development of another, a "correlation of growth" is said to exist; this correlation has been expementally demonstrated in the case of various parts of the vegetative system by Goebel ‡; the appearance of substitutionary growths following sporal arrest points to the existence of a similar correlation of growth in these cases also, and this has been specially recognized by Goebel in recent articles on the doubling of flowers §, and on the fertile cones of the *Equiseta* ‖.

As the substitutionary or correlative growths are of various nature in different cases, it will be necessary to classify them, and they may be ranged under three heads: 1, *simple prolification*; 2, *sporophoric budding*; and 3, *apospory*. Under the first head will fall those examples of extra growth of the single floral shoot or flower associated with sporal arrest, in which the normal order and succession of parts of the vegetative system is continued or, after some irrregularities, resumed; under the head of sporophoric budding would be included all cases of formation of new buds of a sporophoric character following on partial or complete sporal arrest; while the term apospory is applied to those cases where sporal arrest is followed by developments of an oophoric character, resulting from direct vegetative outgrowth from the sporophore. *Simple prolification* is the most direct form in which a substitutionary or correlative growth can present itself; the activity which should, under normal circumstances, be devoted to spore-formation, appears here to be diverted into a purely vegetative channel, and makes itself apparent in the continued growth of the shoot, and even in the formation of fresh lateral organs on the

* Strasburger, 'Angiospermen u. Gymnospermen,' p. 116, &c., Taf. xiii., xiv.

† Strasburger, *l. c.* p. 14, Taf. iv., v.

‡ Bot. Zeit. 1880, p. 753, &c.

§ "Beiträge zur Kenntniss gefüllter Blüthen," Pringsheim's Jahrb. vol. xvii. p. 207.

‖ Berichte der Deutschen. Bot. Gesellsch. 1886, p. 134.

axis; as examples of this may be cited the prolifications of the fertile cones of *Equiseta** ; of *Selaginella Lyallii*†, in which many of the sporangiferous cones were found by Goebel to be proliferous, the apex of the axis having grown further, and branching, while the sporangia of the upper part of the cone were arrested; of the cones in various *Gymnosperms* ‡ so frequently made use of by various writers as throwing light on the morphology of the cone; lastly, in the *Angiosperms* simple prolification, associated often with increase in size of the individual floral leaves beyond the normal, as well as increased length of the axis, has been from early times an object of common observation §. Such proliferations are, in a large number of recorded cases, associated with a partial or complete arrest of spore-formation, and whichever phenomenon be regarded as the true cause of the abnormal development, there can be little doubt that they are closely related to one another, in fact, that there is, in these monstrosities, evidence of a correlation of sporal and vegetative development. A comparison of these cases with certain Pteridophyta will naturally suggest itself, and it is hardly necessary to point out that the relations of the vegetative to the sporal development on the fronds of *Osmunda regalis*, *Aneimia phyllitidis*, *Blechnum Spicant*, various species of *Acrostichum*, &c., clearly show a similar correlation, extending, however, in these cases only to parts of the individual leaf.

Passing now to the second head, under which are included all cases of the formation of new buds of a sporophoric character following on partial or complete sporal arrest, it is obvious that we shall be dealing with phenomena which will graduate off by imperceptible degrees to cases of ordinary sporophoric budding; or, to put it in other words, adventitious buds of a sporophoric character are produced commonly upon the sporophore; sometimes they may be associated with sporal arrest, at other times they appear to be independent of it. Putting aside the latter, there remain a number of cases where budding is associated with sporal arrest. Thus, of the Ferns above described, adventitious sporophoric buds are formed from the base of the sorus in *Athyrium F.-f.* var. *plumosum*, subvars. *elegans* and *divaricatum*, while the formation of spores is, in these cases at least, partially arrested; again, in *Aspidium erythrosorum*, var. *prolificum*, there is a development of a sporophoric bud from the bases of certain sori; but the number of these is smaller than in the cases above mentioned, and it is further to be noted that the arrest of the sporangia and spores is less complete. It will be sufficient in connection with these examples to cite the well-known formation of bulbils or sporophoric buds on the fronds of the *Asplenia*, of *Ceratopteris*, &c., in which the formation of the buds cannot be directly correlated with arrest of spore-formation. In *Isoëtes* a pregnant

* Milde notes it in *E. litorale*, in which the spores are arrested, though it is not a constant character of this plant and in other species. Comp. also Ridley (Journ. Linn. Soc., Bot. xx. p. 47), who describes it in *E. maximum*, but says nothing of the condition of the spores; also Goebel (Ber. d. bot. Gesellsch. 1886, p. 184), who traced the correlation experimentally.

† Goebel, Bot. Zeit. 1880, p. 821.

‡ Masters, Veg. Terat. p. 103, also p. 115, where the early literature is quoted. Comp. also more recent writings by Eichler, Strasburger, &c.

§ Masters, Veg. Terat. p. 136, &c.; also, as an extreme case, Henslow, Journ. Linn. Soc., Bot. xix. pl. xxxii.

example of sporal arrest, and substitution of a sporophoric bud in place of the sporangium, has been described by Goebel*; in these specimens of *I. lacustris* and *I. echinospora*, which grew at considerable depths in the Langemer lake, it appeared that the formation of sporangia was entirely arrested, and the energy of growth diverted into a different channel. As Goebel pointed out, this observation leads naturally on to those malformations of the Phanerogamic ovule which are associated by Masters † under the head of Phyllody (Vergrünung).

Under the third head, of *Apospory*, fall those cases in which the substitutionary growth following sporal arrest results in the formation of organs having the characteristics of the oophore. Starting with the Mosses, such developments have been induced from the sporogonium, by artificial means, by Pringsheim ‡ and by Stahl §; by cutting the seta and capsule of certain Mosses into short lengths, and cultivating them on moist soil, they succeeded in inducing a formation of protonemal filaments directly from the sporogonium without the intervention of spores; the protonema thus produced ultimately formed Moss-plants in the ordinary way. Pringsheim (*l. c.* p. 3) states that this protonema is derived from the fundamental square or endothecium (Grundquadrat), which normally gives rise to the archespore and columella; but Stahl (*l. c.* p. 692, &c.) states that in *Ceratodon purpureus* the formation is not exclusively from this part (Grundquadrat), but more especially from the third and fourth rows of cells from the surface of the wall of the capsule; it is to be noted, in connection with this, that in most cases of a similar growth from the sporangia of Ferns the archespore takes no part in the vegetative process. It was thus established by independent observations that in the Mosses exposure to extraordinary conditions may result in direct transition, by purely vegetative processes, from the sporophore to the oophore without the intervention of spores; a similar direct transition has now been found to occur in two of the Ferns above described, and the special interest attaching to the fact lies in this, that, at least in one case, the peculiarity has been traced in plants found wild, in districts far apart from one another; so that here the phenomenon is *not artificially induced, but natural.* A few attempts have been made by laying portions of fronds of various Ferns, with immature sporangia on them, on moist soil, to induce apospory, as was done by Pringsheim and Stahl in the Mosses; hitherto these experiments have produced no result, but it is quite to be anticipated that if they be extended to a large number of Ferns, especially to those of a variable character, apospory may be induced with success in some of them.

It will be sufficient briefly to recapitulate the observations above detailed: in *Athyrium F.-f.*, var. *clarissima*, the substitutionary growths which accompany the arrest of spore-formation are restricted to the sporangium itself; by growth and division, especially in the superficial cells of the sporangia, irregular masses of cells are produced, which do not at first show the characteristic flattened form of prothalli, though the cells themselves are thin-walled and contain chlorophyll; these masses may attain considerable size and

* Bot. Zeit. 1879, p. 1.

† Veg. Teratology, pp. 262–271.

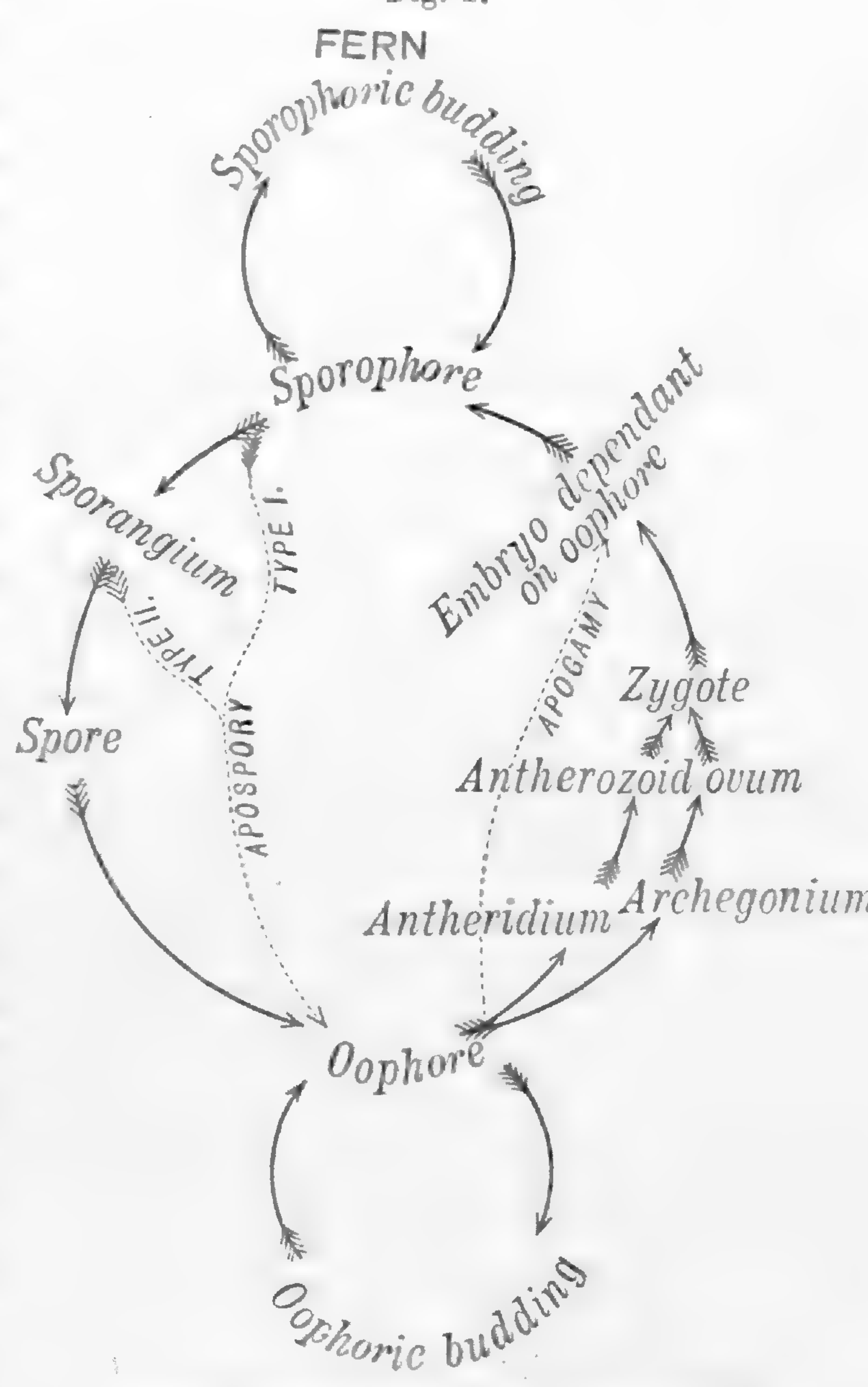
‡ Monatsber. der Berliner Akademie der Wiss., July 10, 1876; also Pringsh. Jahrb. xi. p. 1, observed in *Hypnum serpens*, *H. cupressiforme*, and *Bryum cæspitosum*.

§ Bot. Zeit. (Nov. 1876), vol. xxxiv. p. 689, observed in *Ceratodon purpureus*.

a pear-like form (pseudobulbils of Druery); corresponding small ones, but little advanced from the arrested sporangia, and showing no distinctly prothalloid form, may produce antheridia, and thus betray their true character as oophores; others may sooner or later bear outgrowths showing the characteristic form of prothalli. complicated, it is true, by irregularities of growth; but such irregularities are not uncommonly found in the prothalli of otherwise normal Ferns. These prothalli produce antheridia and archegonia in the normal way, and ultimately young sporophores, which have been further cultivated by Mr. Druery, till they show clearly a repetition of the peculiarities of the parent plant. In the second example of true apospory above described (viz., *Polystichum angulare*, var. *pulcherrimum*, Padley), the prothalloid growths are by no means restricted to the sporangium; there may be found at least four modifications, which have been above tabulated and described; in two of these the prothalli arise from the sorus itself, and thus they may be regarded as direct substitutionary growths since the sporangia and spores are arrested; but in the two other types the prothalli appear at points quite distinct from the sori, and even on fronds which bear no sori at all, and they may thus be compared, as regards their position, with those formations of adventitious sporophoric buds so often found on the fronds of Ferns; again, comparing them with the Mosses, it will be remembered that the stalk or seta of the sporogonium is capable of forming protonema as well as the capsule, while it takes no part in the normal formation of spores. Thus in these two Ferns there is a direct transition from the sporophore to the oophore without the intervention of spores, and by a simple vegetative budding; they are, in fact, examples of apospory, as above defined.

Already, in the preliminary paper on this subject, the attempt has been made to demonstrate to the eye, by means of graphic diagrams, the relation of this short cut to the whole cycle of life in the normal Fern. The annexed diagram, fig. 1, is intended to show this, perhaps more clearly than before. It brings before the eye the facts that the normal cycle may be extended on the one hand by sporophoric budding in its various forms, on the other by oophoric budding as in the gemmæ of Mosses and Lycopods (Treub), the case of formation of gemmæ on prothalli, described by Cramer ("Ueber die Geschlechtose Vermehrung des Farnprothalliums," Denkschr. d. Schweiz. naturforsch. Gesellsch. Bd. xxviii. 1880), &c.; further, how certain stages in

Fig. 1.



Normal life-cycle of a Fern (see p. 326).

the normal cycle may be passed over, and accordingly a short cut may be made from one point directly to another. Two such cases of excision are now recognized—that which is termed *apogamy*, where there is direct transition from oophore to sporophore without sexual process; and *apospory*, where there is direct transition from sporophore to oophore without spores; these may respectively be represented to the eye as in the fig. 1, which further distinguishes those cases where the oophore originates from the sorus (Type II.), from those where it originates from the ordinary vegetative portion of frond (Type I.).

In seeking among the higher plants for cases comparable with these of apospory in the Mosses and Ferns, we must be prepared to find the phenomena less obvious, since in them the oophore becomes suppressed, and the sporal and sexual process of propagation more nearly identical in time and space. I am not aware of any recorded case of true apospory in either the higher heterosporous Pteridophyta or in the Phanerogams; still there are, in those cases of adventitious embryos observed by Strasburger*, sufficient points of similarity to warrant a comparison being drawn. He found in *Funkia ovata*, and in *Nothoscordum fragrans*, that a budding of the cells forming the single remaining layer of the apex of the nucellus results in the formation of numerous embryos in the single ovule, but it was left undecided whether or not fertilization is *necessary*, though the entry of the pollen-tube into the micropyle of the ovule seems usually to precede the formation of the adventitious embryos. Again, in the notorious case of *Cœlebogyne*, adventitious embryos are formed in a similar way, but without fertilization. Now if the cells which thus give rise to the embryos be regarded as ova (which is hardly a possible view, considering their origin, the fact that they are not fertilized, and the continued presence of a cell-wall, &c.), then such cases might be compared with those of the aposporous Ferns, since they would be examples of production of the ova more or less directly from the sporophore; this would, however, be a somewhat strained interpretation, and it seems more reasonable to regard these adventitious embryos rather as peculiar examples of sporophoric budding, associated more or less closely with a process of fertilization in *Funkia* and *Nothoscordum* but independent of it in the case of *Cœlebogyne*. It is to be noted that these adventitious growths follow a certain arrest of function in the embryo-sac itself; the true ovum does not appear to be functional in these plants, and accordingly the appearance of the adventitious embryos may be regarded as a correlative or substitutionary growth †.

Lastly, it remains to discuss the case of *Chara*, to which, it will be remembered, the term "aposporous" was first applied by Vines ‡; he made the ingenious suggestion that in the life-history of *Chara* there is to be traced a true alternation of generations; that the proembryo is to be regarded as the sporophore, which, however, does not produce spores, but by a process of aposporous budding the oophore is produced by direct vegetative growth from the sporophore; in fact, he suggests that the condition which can be artificially induced in the Mosses is the normal and constant condition in *Chara*. It must be admitted on all hands that this is a pure hypothesis; beyond the fact that

* Befruchtung, p. 63, plates vi., vii.

† The case of *Disciphania* described by Ernst ('Nature,' Oct. 7, 1886) may be mentioned here, though it is not yet clear whether it be a true case of parthenogenesis or of sporophoric budding.

‡ Journ. of Botany, 1878, p. 355.

the presumable oophore originates as a *lateral* outgrowth from the presumable sporophore, there is little foundation for the view. We may well ask, is every lateral bud to be looked at in this light, or if not, where is the line to be drawn? It is found in the Mosses that, though in some cases the leafy buds do originate from the ends of protonemal filaments, they are, in the large majority of cases, lateral outgrowths; it seems unnecessary on this ground to assume a third alternating generation in the life-cycle of the Mosses; why, then, should so different an interpretation of the lateral budding be given in two groups of plants, which Dr. Vines admits (*l. c.* p. 361) to have strong affinities? But, again, the protonemal filaments formed in Pringsheim's and Stahl's cultures of the seta are not formed laterally, they usually appear longitudinally at the cut ends of the seta; thus even these cases of known apospory do not bear out Dr. Vines's hypothesis. Since the *Characeæ* are of doubtful affinity, and since within the family itself there is no direct evidence for or against the view of Dr. Vines (for the further development of the presumable sporophore has never been observed), it would be rash to affirm a direct negative to the suggestion; it must remain as a pure hypothesis until more cogent evidence is produced on one side or on the other.

The phenomena of apospory may now be considered from the biological aspect: we have seen that the most prominent examples of it occur in isosporous plants; in these it is obvious that by means of spores the plant provides for the production of a large number of new individuals at a comparatively small cost to itself; while, owing to their small size, the spores are easily scattered, and the new individuals will thus be saved from entering into competition with the parent and with one another. There is no apparent reason for assuming that the formation of spores has any deeper significance than this in isosporous plants, where spore-formation is quite distinct from the sexual process; further, the fact that the organism produced from the spore (the oophore) differs more or less from the sporophore, need not be regarded as of any more fundamental meaning than this, that in a certain stage of its cycle of life (the oophore) the plant adapts its vegetative structure to the production of sexual organs, and the temporary or permanent support of the embryo, there being *no marked increase in number* of individuals; while in another stage (the sporophore) it is adapted to carrying on vegetative functions ending in the formation of spores; these, if they germinate successfully, will ensure an *increase in number* of individuals. Now in those isosporous plants which show either induced or spontaneous apospory, the organism appears to exchange the chance of a great increase in number of individuals for a greater certainty of production of a few; instead of sowing the earth thickly with spores, only a few of which may succeed in passing the various dangers of germination and difficulties of self-support, the aposporous plants form by direct outgrowth a comparatively small number of prothalli, which have this great advantage over prothalli raised from spores, that for a considerable period they are supplied with nourishment from the parent plant *. It must be admitted that the rarity

* It will be remembered that in certain cases the prothalloid growths assume a massive form, no doubt adapting themselves to the storage of nourishment thus derived. It seems then that in some cases these aposporous growths assume, as regards their nourishment, a condition not unlike that of the macrospores of the higher forms, since they carry with them a considerable store of reserve materials from the parent plant.

of occurrence of apospory and its appearance (as far as yet observed) either under exceptional circumstances (Mosses), or only in species of a very variable character (Ferns) afford strong evidence that the exchange is not a real advantage to the plant; if the excision of the sporal stage from the cycle of life were a decided gain, we might well have expected to find the peculiarity to be not only common but also permanent *.

It is a striking fact that in one of the aposporous Ferns (*Polyst. ang.*, var. *pulcherrimum*) prothalli are formed on the fronds while they are still erect; further it is to be remembered that in my first observations on the prothalli of this Fern, neither antheridia nor archegonia were in a position to effect the sexual process, since neither had opened †: presumably this is to be ascribed to their not having access to fluid water; this must often be the case with prothalli produced early on the erect fronds: thus, in this instance, the delay before effecting sexual reproduction, as well as the smaller number of oophores produced, must be set against the advantage of greater security of nutrition; it is difficult to see how any balance of advantage from apospory could remain to this plant. In the *Athyrium F.-f.* var. *clarissima* the case is clearer; this Fern is deciduous, and when the fronds reach the soil, the same processes may promptly be gone through in nature as have been observed in the cultures in the laboratory: thus, in this case, it is only by the production of a smaller number of oophores that the plant loses, while it gains in the certainty of their nutrition in early stages. It has been already noted that these two cases of apospory in Ferns are found in varieties of very variable species ‡; if the above conclusions be correct, it is among deciduous rather than evergreen Ferns that further examples of apospory are to be anticipated, and especially in those deciduous species which are most subject to variation.

Already the observations of Pringsheim and Stahl have had their effect in demonstrating that no fixed and impenetrable barrier exists between the sporophore and the oophore; in fact, that the formation of spores is not a *necessary* stage in the cycle of life in isosporous forms. This conclusion is greatly strengthened by the above observations on aposporous Ferns; and the more so that both the present examples are natural, and not brought about under the stress of artificial circumstances. It is now clear that the Fern prothallus may grow out from characteristic tissues of the sporophore, and, further, that where apospory occurs, it does not necessarily originate from a single cell, which might thus be taken as representing the spore, but from a number of cells, there being no sharp limit between the characteristic sporophore and the characteristic oophore. A further question which here suggests itself is this: Are these phenomena of apospory to be regarded as mere sports, or as having a deep morphological meaning, and throwing light upon the origin of the two distinct generations? To me the former interpretation seems the more in accordance with the facts; it is to be

* Mr. Druery tells me that signs of reversion to the normal type are to be found in *Polyst. angulare*, var. *pulcherrimum*; Col. Jones's impression that *Athyr. F.-f.* var. *clarissima* did not, when first found, present the peculiarities now described may also be noted.

† Journ. Linn. Soc., Bot. vol. xxi. p. 363, also plate xii. figs. 11, 12.

‡ Compare Lowe ('Our Native Ferns'), who describes over 100 varieties of *Polystichum angulare*, and more than 200 varieties of *Athyrium Filix-fœmina*.

remembered that in both the described cases the early stages of development of the sorus are according to the normal type; also, that if the abnormality be regarded as a reversion, the deductions which would follow from this would apply equally well to those sporophoric buds which arise in the plumose *Athyria* in similar relation to the sorus. Again, the view that these abnormalities are reversions to an ancient type would run counter to those views of phytogeny which have been based upon a diligent comparison of known forms; in such a series of plants as *Œdogonium*, *Coleochæte*, *Riccia*, and *Anthoceros* there is ample indication of the formation of spores before the sporophore assumed its vegetative characters; in the lowest of this series the whole of the zygote goes to form the spore; it is only in the later terms of the series that a differentiation of vegetative tissue of the sporophore from the true spore-forming tissue becomes apparent. Thus, on phytogenetic grounds, it appears improbable that apospory is a true reversion. In the former of his papers on the Lycopodiaceæ *, Treub draws attention to "the remarkable resemblance which exists between the young plant (asexual generation) and the prothallus (sexual generation)" in *Lycopodium cernuum*; he also remarks, "the fact that the prothallus of *Lycopodium cernuum* is rather more differentiated than the prothalli known in other Vascular Cryptogams, makes this resemblance more striking;" and continues, "I think I am able to state that in none of the Vascular Cryptogams is the analogy between the young asexual generation and the sexual generation so great as in *Lycopodium cernuum*; the fact is so interesting that I may be allowed to draw special attention to it now." This being so, if apospory be regarded as a reversion, it is among the Lycopods that we might well expect to find apospory occurring: hitherto, there is no recorded case of it in this family, a fact which further supports the view above expressed that the phenomenon of apospory is a sport, and not a reversion bearing pregnant interpretations with it †.

It can scarcely be a matter of surprise that, as we leave the isosporous forms and ascend in the scale to the heterosporous plants, the phenomena of apospory should, if present at all, be less prominent. Where microspores are formed, it is clear that their arrest would entail loss of sexual function; unless, indeed, single cells of the sporophore should act as pollen-tubes and effect fertilization: this has, as far as I am aware, never been observed; still it must be regarded as a possibility in the light of the facts of apospory in the isosporous forms. If, on the other hand, the macrospore be arrested, a substitutionary or aposporous development might take the form of the production of ova (either directly or with previous cell-division) from ordinary cells of the sporophore: in Strasburger's examples of *Funkia* and *Nothoscordum* we have at least a near approach to this, since the actual function of formation of embryos is assumed by superficial cells of the nucellus; here, however, there is apparently no fertilization of those cells, nor any previous divisions corresponding to those in the embryo sac: accordingly, they

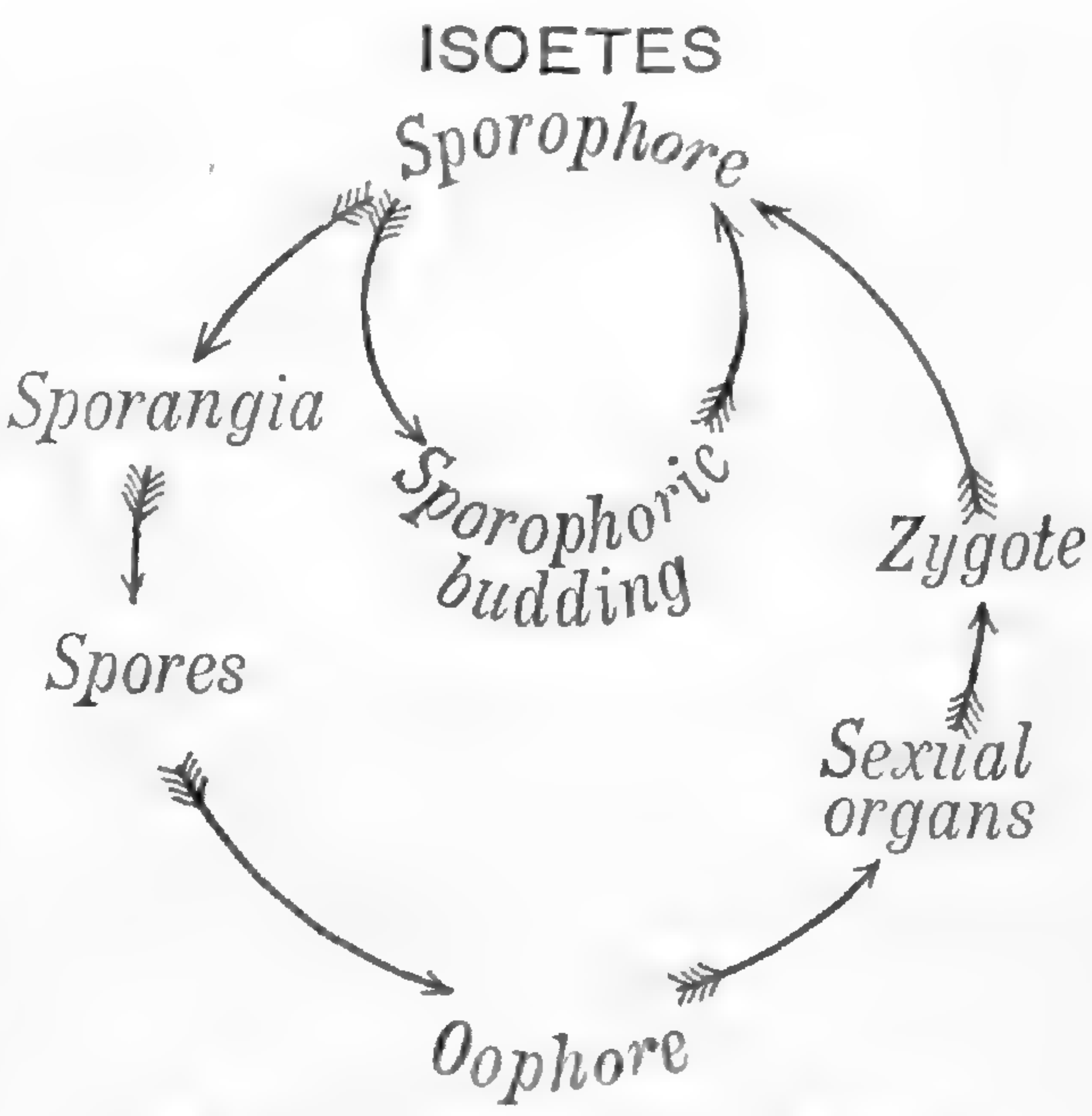
* "Etudes sur les Lycopodiaceæ," par M. Treub, Ann. du Jard. Bot. de Buitenzorg, vol. iv. p. 135.

† The general result of investigations on monstrosities in flowers of the higher plants may be compared with this (*cf.* Goebel, "Vergl. Entwicklungsgesch. der Pflanzenorgane," Schenck's Handbuch, vol. iii. p. 114, &c.).

cannot strictly be regarded as ova, or representatives of the oophore. Nevertheless the production of ova, directly or indirectly, from cells of the sporophore is also to be regarded as a possibility, and it will be well that those who investigate cases of Polyembryony and apparent cases of Parthenogenesis in the future should bear such possibilities in mind.

Another interesting question is this, How are we to regard those sporophoric buds which arise as substitutionary growths in connection with arrested sporangia? Goebel, in describing his examples of *Isoëtes* in which the sporangia were replaced by sporophoric buds, writes as follows (*l. c.* p. 5):—"Here there is obviously a case which belongs to the series of phenomena recently styled by De Bary as 'Apogamy, or loss of sexual function.' Only in the case above described the sexual organs are not arrested or lost, but the whole sexual generation." Such a view might be expressed graphically by the annexed diagram, fig. 2. Does this interpretation apply for the cases of sporophoric budding described above in the plumose *Anthyria*, &c.? It has already been pointed out that these cases of sporophoric budding graduate almost imperceptibly into those which arise quite apart from the sori, as in various *Asplenia*, and it would be difficult to apply the same explanation to these. For such difficulties, any one who is conversant with morphological treatment will be prepared, and no great exception can be taken to the application of Goebel's view to those cases where sporophoric budding is really associated with sporal arrest, while those of mere formation of buds at points remote from the sori will fall naturally under the head of vegetative reproduction of the sporophore; these might be represented graphically as in diagram 2 of my former paper (*l. c.* p. 364), as a subsidiary circle or eddy, outside the main cycle of life. The distinction is admitted to be an artificial one, but so are many which are drawn by morphologists.

Fig. 2.



Life-cycle of *Isoëtes* (see p. 326).

DESCRIPTION OF THE PLATES.

Plate LVII.

Athyrium Filix-fœmina, var. *clarissima*.

Fig. 1. Section through a sorus, showing the condition of the sporangia in August; the archespore is already arrested in the oldest sporangium. (× 175) *ind*=indusium.

Fig. 2. A–F, various types of development of sporangia, from material taken in August. The shading indicates the extent of the brown colouring which often follows arrest; the archespore may be seen in each case. (× 175)

Fig. 3. An arrested sporangium with annulus already formed, but its cell-walls not thickened; the cells of the head of the sporangium have almost lost their contents, while those of the stalk (*st*) have abundant protoplasm and chlorophyll granules. (×325.)

Fig. 4. A sporangium taken from a sorus after cultivation on moist soil, at high temperature, for seven days. The shaded head of the sporangium has not grown, but active cell-division and growth have gone on in the stalk (*st*). (×325.)

Fig. 5. Sporangium after germination at normal temperature for three months: the head (*h*) has not grown; irregular outgrowths from the stalk (*st*) immediately below it. (×175.)

Fig. 6. An arrested sporangium in which the archespore (*a*) remains undivided; the stalk (*st*) is abnormally enlarged, and its cells as well as the superficial cells of the head have abundant protoplasm and chlorophyll. (×325.)

Fig. 7. A similar sporangium, as seen in optical section after culture at normal temperature for three months. (×175.)

Fig. 8. Superficial view of a similar sporangium, with enlarged head. (×325.)

Fig. 9. Ditto, head not enlarged, but whole sporangium elongated. (×175.)

Fig. 10. Sporangium, after culture for three months, developed as a solid cylindrical mass. *gl*= glandular hair, *st*=stalk. (×175.)

Fig. 11. Ditto, ditto, an antheridium (*anth*) already showing characteristic structure. (×175.)

Fig. 12. A sporangium after seven days' cultivation at high temperature, showing a flattened irregular outgrowth from the stalk. (×325.)

Fig. 13. Ditto, after twelve days, growth with a wedge-shaped apical cell has begun laterally on the enlarged stalk. (×130.)

Plate LVIII.

Athyrium Filix-fœmina, var. *clarissima* (continued).

Fig. 14. A flattened expansion produced by cultivation of an arrested sporangium; growth with a wedge-shaped apical cell appears to be progressing at more than one point. (×130.)

Fig. 15. Part of a pinnule, with vascular bundles (*v.b.*) and one sorus. Cultivation, at a high temperature, for five weeks has resulted in the development of prothalli from some of the arrested sporangia; these prothalli bear antheridia and archegonia, but are still attached to the pinnule which bore them. (×40.)

Fig. 16. Single prothallus from a similar culture, showing antheridia. *st*=stalk of sporangium, *an*= antheridia, *r*=root-hairs. (×65.)

Polystichum angulare, var. *pulcherrimum*.

Fig. 17. Tip of a normal pinnule as seen in surface view. (×130.)

Fig. 18. Tip of a pinnule which has begun to assume a prothalloid character with thin cell-walls: as yet there is no distinct apical cell. (×130.)

Fig. 19. A similar growth more advanced. (×20.)

Fig. 20. Apex of the same under higher power, there is no apical cell, no cushion, nor sexual organs. (×130.)

Fig. 21. Flattened expansion from apex of pinnule has attained considerable size, and typical characters of prothallus, with glandular hairs (*gl*), cushion (*c*), and sexual organs, which proved, on cutting sections of the prothallus, to be antheridia and archegonia. (×20.)

Fig. 22. Tip of pinnule, showing a prothalloid growth (*prth*) beginning on the surface above the ending of the nerve (*vb*). (×20.)

Fig. 23. Section through such a prothalloid growth (*prth*), the end of the nerve (*vb*), and the apex of the pinnule (*ap*). (×175.)

Plate LIX.

Polystichum angulare, var. *pulcherrimum* (continued).

Fig. 24. Longitudinal section through the base of one of these prothalloid growths when older; it shows how the vascular bundle (*v.b.*) may be traced a short way into the base of the prothalloid growth. (×20.)

Fig. 25. Transverse section of one of the cylindrical prothalloid growths above the ending of the vascular bundle. (×130.)

Fig. 26. Heterocysts from tissue of the prothalloid growths. (×175.)

Fig. 27. One of the cylindrical prothalloid growths which originate from the surface of the pinnule. *ap*=its apex, *h*=root-hairs, *arch*=archegonia, *v.b.*= vascular bundle of the pinnule. (×10.)

Fig. 28. Ditto: the apex is beginning to assume the distinctly flattened form. (×10.)

Fig. 29. Ditto, more advanced, with distinct flattened expansion at apex, as in normal prothallus. *x*= irregular lateral outgrowth. (×10.)

Fig. 30. Apex of pinnule, showing attempts to form prothalli both from the surface (*prth. B*) and from the apex (*prth. A*). (×20.)

Fig. 31. An arrested sporangium, showing results of vegetative growth. (×325.)

Fig. 32. Ditto, more advanced, after culture at normal temperature for about three months; two antheridia (*a*) are already produced on it. *sp*=arrested sporangia which have not grown. (×175.)

Fig. 33. Section of sorus, after eight months' culture, showing a prothalloid outgrowth, apparently from the stalk of a sporangium (*sp*), bearing an antheridium (*anth*). (×70.)

Figs. 34 & 35. Ditto, showing prothalloid outgrowths from base of sorus (*b*). (×175.)

Fig. 36. A sorus separated from the frond, and inverted, showing indusium (*ind*), arrested sporangia (*s*), and prothalloid outgrowths from the base of the sorus; one of these is elongated and filamentous: cultivated for three months. (×70.)

Athyrium Filix-fœmina, var. *plumosum elegans*.

Fig. 37. Sorus in surface view, after a short period of germination on moist soil. *x*=irregular outgrowths; *s*=sporangia. (×20.)

Fig. 38. Ditto, not germinated. (×35.)

Fig. 39. Ditto, germinated about two and half months. (×20.)

Fig. 40. Section through a sorus. (×20.)

Athyrium Filix-fœmina, var. *plumosum divaricatum*.

Fig. 41. Section through a sorus, showing sporangia (*sp*), an irregular outgrowth of the base of the sorus (*x*), and a bud (*ap*), with one leaf (*l*), also derived from the base of the sorus. (×20.)

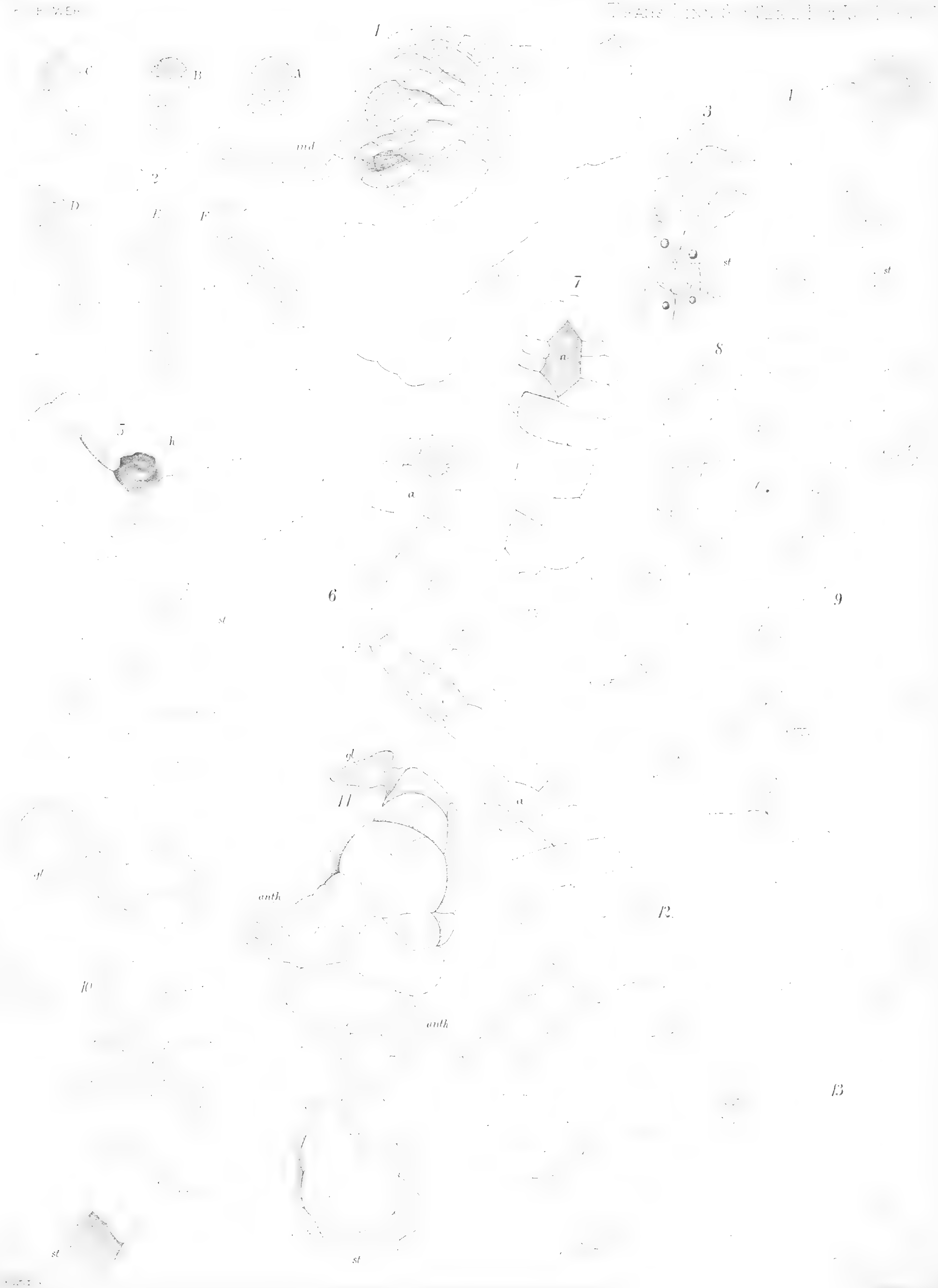
Aspidium erythrosorum, Eat., var. *monstrosum*.

Fig. 42. Section through the sorus, showing the indusium (*ind*) partly in surface view, the sporangia (*sp*), and the bud (*bd*), with a leaf (*l*) originating from the base of the sorus. (×30.)

Description of the Woodcuts.

Fig. 1, p. 319. A diagram illustrating the normal cycle of life of a Fern, and putting in relation with it the extensions of the cycle by sporophoric and oophoric budding, and also those short cuts which pass under the terms apospory and apogamy.

Fig. 2, p. 324. A similar diagram of the cycle of life of *Isoëtes*; the inner circle is intended to indicate how the cases described by Goebel may be graphically represented, supposing the view be adopted that the sporophoric buds, which replace the sporangia, are really examples of excision of the sporal and sexual stages from the life-cycle.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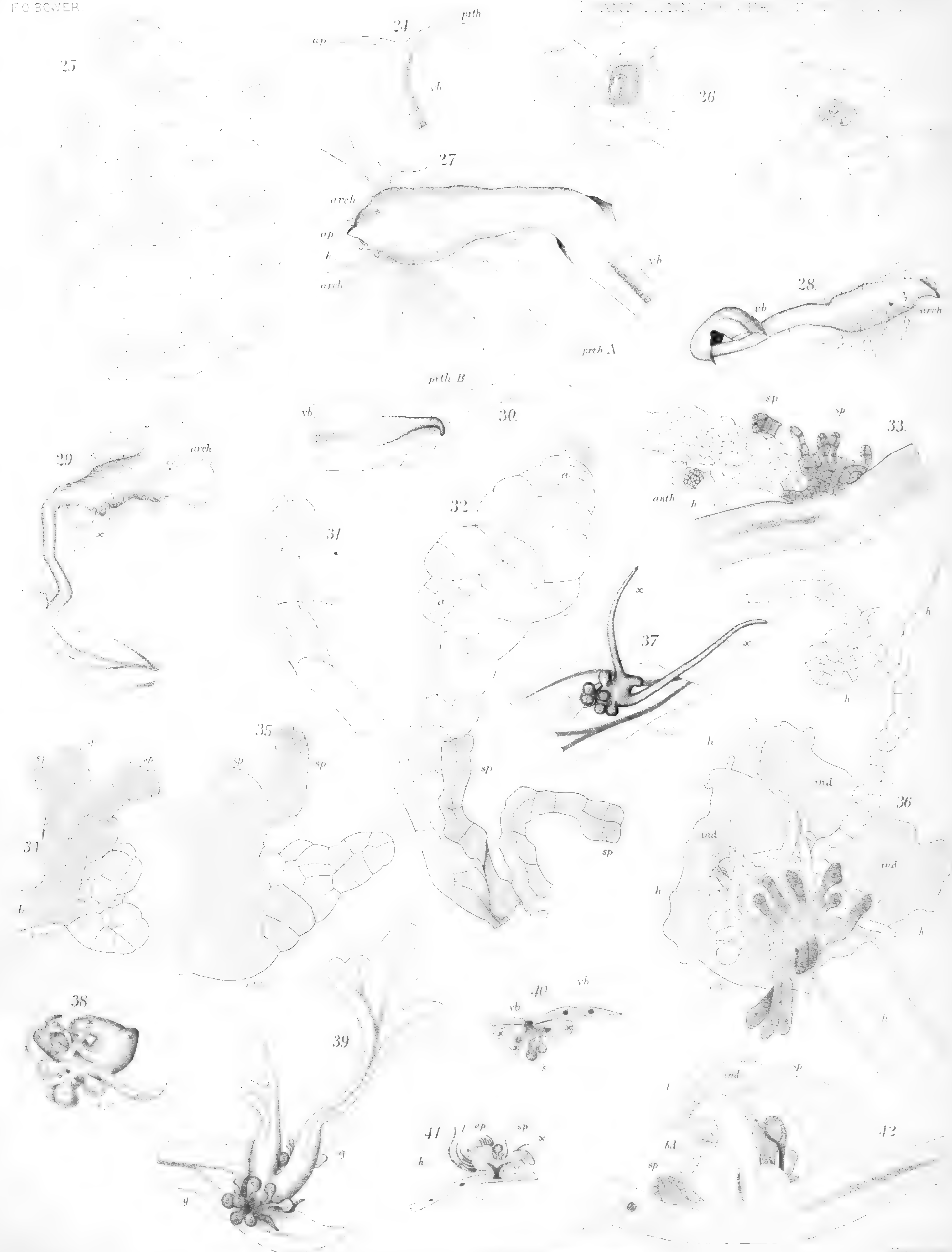

APOSPORY AND ALLIED PHENOMENA.

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	Part XVII.	1886.	0	3	0	0	2	3
SECOND SERIES.—ZOOLOGY (*continued*).								
III.	Part I.	1884.	1	14	0	1	5	6
	Part II.	1884.	1	12	0	1	4	0
	Part III.	1885.	1	10	0	1	2	6
	Part IV.	1885.	0	8	0	0	6	0
IV.	Part I.	1886.	1	4	0	0	18	0
SECOND SERIES.—BOTANY.								
I.	Part I.	1875.	0	8	0	0	6	0
	Part II.	1875.	0	16	0	0	12	0
	Part III.	1876.	0	12	0	0	9	0
	Part IV.	1876.	0	10	0	0	7	6
	Part V.	1878.	1	4	0	0	18	0
	Part VI.	1879.	1	6	0	0	19	6
	Part VII.	1880.	1	4	0	0	18	0
	Part VIII.	1880.	1	1	0	0	16	0
	Part IX.	1880.	1	0	0	0	15	0
II.	Part I.	1881.	0	12	0	0	9	0
	Part II.	1882.	0	5	0	0	3	9
	Part III.	1883.	0	10	0	0	7	6
	Part IV.	1883.	0	3	0	0	2	3
	Part V.	1883.	0	3	0	0	2	3
	Part VI.	1884.	0	13	6	0	10	0
	Part VII.	1884.	0	9	6	0	7	0
	Part VIII.	1884.	0	10	0	0	7	6
	Part IX.	1886.	0	7	0	0	5	0
	Part X.	1887.	0	3	4	0	2	6
	Part XI.	1886.	0	6	0	0	4	6
	Part XII.	1886.	0	8	0	0	6	0
	Part XIII.	1887.	1	7	0	1	0	0
	Part XIV.	1887.	0	7	0	0	5	0

2nd Ser. BOTANY.] [VOL. II. PART 15.

THE

TRANSACTIONS

OF

THE LINNEAN SOCIETY OF LONDON.

ENUMERATION OF THE PLANTS COLLECTED BY MR. H. H. JOHNSTON ON THE KILIMA-NJARO EXPEDITION, 1884.

BY PROFESSOR D. OLIVER, F.R.S., F.L.S., AND THE OFFICERS OF THE KEW HERBARIUM.

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October 1887.

XVII. *Enumeration of the Plants collected by* Mr. H. H. Johnston *on the Kilima-njaro Expedition,* 1884, *by* Prof. D. Oliver, *F.R.S., F.L.S., and the Officers of the Kew Herbarium.*

(Plates LX.–LXIII.)

Read 3rd June, 1886.

With the exception of *Anisotes parvifolius*, Oliv. (Acanthaceæ), belonging to a genus known previously only from Arabia and Socotra, the species here first described belong to genera already recorded from Tropical Africa.

The genus *Valeriana* is here recorded for the first time from Tropical Africa, I believe; but the single specimen brought home hardly suffices for description; a species of the genus occurs at the Cape. A single specimen also of an *Anthoxanthum* was gathered at 13,200 ft. on Kilima-njaro, possibly a robust form of *A. odoratum*; this is a second genus here first noted from Tropical Africa.

This enumeration, before it was put in its final form, Mr. Johnston copied for the Appendix to his 'Narrative of the Kilima-njaro Expedition' (London, Kegan Paul & Co., 1886), omitting the descriptions. The plant which in his Appendix is called *Hormolotus Johnstoni*, Oliv., I have since identified with *Antopetitia abyssinica*, Rich., now referred to *Ornithopus*, and the *Senecio Valeriana*, Oliv., I have thought it better to refer to *Gynura*. With the *Astephania africana*, Oliv., of the Appendix, I propose to associate generically a plant which I described in 'Icones Plantarum' (tab. 1451) as a doubtful *Sphacophyllum* from Zambesia (*see below* p. 339). Dr. Masters, F.R.S., has kindly described for us a new *Tryphostemma*, and Herr O. Bœckler has named three new Cyperaceæ.—D. Oliver.

Clematis Thunbergii, Steud., var. hirta (foliis *C. Wightianæ*). 3000–5000 ft.

Thalictrum rhynchocarpum, Dill. & Rich. 7000 ft.

Ranunculus oreophyllus, Del. 8000–11000 ft.

Ranunculus pinnatus, Poir. 8500 ft.

Anemone Thomsoni, Oliv. in Hook. Ic. Pl. t. 1491. 9000–13,000 ft.

Uvaria leptocladon, Oliv., sp. nov.; ramulis gracilibus ultimis fusco-tomentellis, foliis breviter petiolatis oblanceolato-ellipticis acuminatis basi rotundatis subtus minute stellato-pubescentibus supra opacis nervo medio excepto glabratis, floribus sæpius geminis ternisve, pedunculo brevissimo, pedicellis 5–8 lin. longis stellato-tomentellis, sepalis late ovatis obtusiusculis inferne coalitis submembranaceis extus tenuiter stellato-tomentellis, petalis calyce subduplo longioribus ovato-ellipticis v. interioribus ovato-oblongis breviter et dense tomentellis, ovariis hirtis pluri- (circ. 8–10-) ovulatis.

Taita, 2000 ft.

Folia $2\frac{1}{2}$–$3\frac{3}{4}$ poll. longa, 1–$1\frac{1}{2}$ poll. lata; petiolus 1 lin. longus. Sepala $\frac{1}{4}$ poll. longa petala 4–5 lin. longa.

Hildebrand no 1971, from near Mombassa, may be a form of the same species.

STEPHANIA ABYSSINICA, Rich., var. TOMENTELLA ?

So far as I can see, differing only from some of our specimens of *S. abyssinica*, e. g. Dr. Welwitsch's no. 2322 (1322 Distr. Esc. Polytech.), in the thin tomentum of the extremities, petioles, nervation of the leaves underneath, and peduncles; in these particulars agreeing with the South-African *Stephania* named *Homocnema Meyeriana* by Mr. Miers.

Kilima-njaro, 5000 ft.

ARABIS ALPINA, L. 8000–11,000 ft.

CARDAMINE AFRICANA, L. 8000–9000 ft.

CARDAMINE JOHNSTONI, Oliv., sp. nov. Herba adscendens v. subdebilis; caule glabro v. parcissime pilosulo, foliis caulinis membranaceis petiolatis imparipinnatis, foliolis petiolulatis ovatis lateralibus sæpius obliquis utrinque late 1–3-crenato-lobatis, lobis mucronatis, parce pilosulis glabratisve, racemis terminalibus glabris, floribus majusculis purpurascentibus, siliquis longiuscule pedunculatis adscendentibus anguste linearibus glabris, valvis enerviis, apice in stylo angustatis.

Kilima-njaro, 8000 ft.

Herba $\frac{3}{4}$–$1\frac{1}{2}$–2-pedalis. Folia cum petiolo poll. longa; foliola $\frac{2}{3}$–$1\frac{1}{4}$ poll. longa, $\frac{1}{3}$–$\frac{5}{6}$ poll. lata. Flores 3–4 lin. longi; sepala elliptica obtusa marginibus hyalinis; petala oblanceolata v. obovata calyce $2\frac{1}{2}$–3-plo longiora; filamenta subfiliformia; stigma (temp. florifero) emarginatum. Siliqua $1\frac{3}{4}$–2 poll. longa, $\frac{1}{16}$–$\frac{1}{20}$ poll. lata; stylo persistente 1–2 lin. longo.

FARSETIA STENOPTERA, Hochst., forma. Taita.

CLEOME MONOPHYLLA, L. Kilima-njaro, 6000 ft.

COURBONIA DECUMBENS, Brongn., var. PARVIFOLIA. Kilima-njaro, 5000 ft.

CAYLUSEA ABYSSINICA, Fisch. & Mey. Kilima-njaro, 5000 ft.

VIOLA ABYSSINICA, Steud., forma foliis cordato-rotundatis. 8000–10,500 ft.

PITTOSPORUM ABYSSINICUM, Hochst. Kilima-njaro, 5000-6000 ft.

POLYGALA SENENSIS, Klotzsch. Maungu.

SILENE BIAFRÆ, Hook. f., v. *S. Burchellii*, Ott. (imperfect single specimen). Kilima njaro, 11,000 ft.

CERASTIUM VULGATUM, L, forma. 7000 ft.

CERASTIUM AFRICANUM, Oliv. 9000–10,000 ft.

DRYMARIA CORDATA, Willd. 6000 ft.

HYPERICUM LANCEOLATUM, Lam. 6000–7000 ft.

HYPERICUM KIBOENSE, Oliv., sp. nov. Herba adspectu *H. perforati*, erecta ramosa glabra, caule terete ramulis adscendentibus gracilibus; foliis parvis oblongo-ellipticis obtusis interdum mucronulatis brevissime petiolatis subtus punctatis, cymis terminalibus floribus mediocribus pedicellatis, sepalis lanceolatis acutis acuminatisve sæpius plus minus serrulatis margine nigro-punctatis dein rigidiusculis nervosis, petalis calyce subduplo longioribus obovatis margine nigro-punctatis, stylis 3 basi liberis ovario æquilongis.

Kilima-njaro, 13,000 ft.

Herba 2–3-ped. Folia (ramulorum) 4–5 lin. longa. Flores $\frac{2}{3}$–$\frac{3}{4}$ poll. diam.

HYPERICUM SCHIMPERI, Hochst. (approaching *H. Quartinianum*, Rich., which may be only a form of it). Kilima-njaro, 5000–6000 ft.

SIDA GREWIOIDES, Guill. & Perr. 4400 ft.

SIDA SCHIMPERIANA, Hochst. (*Dictyocarpus truncatus*, Wight.) Kilima-njaro, 5000 ft.

ABUTILON ASIATICUM, L.? (vel *A. indicum*, Don). 4300 ft.

PAVONIA SCHIMPERIANA, Hochst. 6000 ft. and upwards.

KOSTELETZKYA ADOENSIS, Hochst., var. HIRSUTA. 6000 ft.

HIBISCUS VITIFOLIUS, L. 6000 ft.

HIBISCUS LUDWIGII, Eckl. & Zey. (of Mast. in Fl. Trop. Afr. i. 203). 6000 ft.

HIBISCUS GOSSYPINUS, Thunb. 6000 ft.

HIBISCUS SCHIZOPETALUS, Hook. f. 40–60 miles from coast.

HIBISCUS PLATYCALYX, Mast. Maungu.

WALTHERIA AMERICANA, L. Kilima-njaro, 5000 ft.

MAHERNIA EXAPPENDICULATA, Mast., var. TOMENTOSA? an sp. distincta? Taveita.

MAHERNIA EXAPPENDICULATA, Mast., var.? Kilima-njaro, 5000 ft.

GREWIA SALVIÆFOLIA, Heyne, forma. Taveita.

GREWIA SALVIÆFOLIA, Heyne, forma foliis obtusioribus. Kilima-njaro, 5000 ft.

TRIUMFETTA an *T. pilosa*? (Fl. Trop. Afr. i. 257). 6700 ft.

SPARMANNIA ABYSSINICA, Hochst., var. HIRSUTA. 7000 ft.

TRIASPIS AURICULATA, Radl. Maungu, and 40–60 miles from coast.

MONSONIA BIFLORA, DC. (*M. angustifolia*, Roxb.). Taveita.

GERANIUM ACULEOLATUM, Oliv. 6000 ft.

GERANIUM ACULEOLATUM, Oliv., forma parvifolia. 7000 ft.

GERANIUM SIMENSE, Hochst. 6000 ft.

GERANIUM SIMENSE? Hochst., forma. 11,000 ft.

GERANIUM (inadequate). 10,000 ft.

GERANIUM OCELLATUM, Camb., var. 6000 ft.

We have the same from the lower plateau, north of Lake Nyassa, collected by Mr. Thomson. The carpels have their transverse ridges very minutely whitish-setulose.

OXALIS CORNICULATA, L., var. 4400 ft.

IMPATIENS WALLERIANA, Hook. f. Kilima-njaro, 5000 ft.

IMPATIENS KILIMANJARI, Oliv. 8500 ft., 7000 ft., and "up to 10,200 ft."

IMPATIENS. 8500 ft. (and no. 25, 8000 ft. ?). Two alternate-leaved species, with solitary axillary flowers, I hardly venture to describe in the present state of our material for comparison. They are distinct specifically from each other; both are allied to *I. micrantha*, Hochst., and to *I. capensis*, Thunb. In neither does the spur exceed (or, if so, but slightly) the petals.

IMPATIENS, sp. Single species with 4–5-fid spur-apex. 7000 ft.

TODDALIA, sp. ? aff. *T. aculeatæ*, Pers. ? (no fruit). Lanjora.

TODDALIA, sp. ? (no fruit). Kilima-njaro, 4000–5000 ft.

HARRISONIA ABYSSINICA, Oliv. Kilima-njaro, 5000 ft.

OCHNA (in fruit), an *O. leptoclada*, Oliv. ? Kilima-njaro, 5000 ft.

TURRÆA FLORIBUNDA, Hochst., var. MACRANTHA.

A South-African species which we had not previously in the tropical flora, but differing remarkably from the type in having the flowers 2 to 3 times larger, the staminal column $3\frac{1}{2}$ in., the style $4\frac{1}{2}$ in. in length. The leaves are not expanded at the time of flowering as in the Natal plant, but the young unfolding ones correspond.

Kilima-njaro, 5000 ft.

TURRÆA NILOTICA, Kotschy & Peyr., var. ROBUSTA.

A form of this species with leaves at length glabrate and with larger flowers, the calyx slightly deeper and more campanulate. Flowers to end of staminal tube $\frac{1}{2}$ inch, to extremity of much exserted style 1 inch. The fruit is depressed-globose, about $\frac{1}{2}$ in. diam.

Maungu, 2000 ft.

RHAMNUS PRINOIDES, L'Hér. Kilima-njaro, 5000 ft.

ZIZYPHUS JUJUBA, Lam., var. OBTUSIFOLIA. Taita.

ZIZYPHUS PUBESCENS, Oliv., sp. nov. Inermis, ramulis hirtellis ultimis flavido-fuscis, foliis ovato-ellipticis obtusis v. obtusiusculis basi oblique rotundatis serrulatis utrinque pubescentibus, stipulis sæpius deciduis lineari-subulatis hirtis, cymis parvis paucifloris breviter pedunculatis hirtellis, calycis lobis deltoideis acutis extus hirtis, stylo bifido.

Kilima-njaro, 2000–3000 ft.

Folia 1–$1\frac{1}{2}$ poll. longa, $\frac{2}{3}$–$\frac{3}{4}$ poll. lata; petiolus 1–2 lin. longus.

We have fruiting specimens of probably the same species from Zambesia (between Lupata and Tette) collected by Sir John Kirk, differing only in the much larger leaves, $2\frac{1}{2}$–$3\frac{1}{2}$ in. long, 1–$1\frac{3}{8}$ in. broad. The fruit is obovoid, more or less apiculate, glabrate, about 5 lines long.

VITIS ROTUNDIFOLIA, Fres. ? (imperfect). Kilima-njaro, 5000 ft.

VITIS ARGUTA, Hook. f. var. ?

Though with minor differences, I cannot venture to separate this plant from *V. arguta*, previously known only from Western Africa. Kilima-njaro, 5000–6000 ft.

VITIS CYPHOPETALA, Nees, forma. 2000–6000 ft.
VITIS ERYTHRODES, Fres. Kilima-njaro, 6000 ft.
DEINBOLLIA INSIGNIS, Hook. f.? Kilima-njaro, 5000 ft.
SCHMIDELIA RUBIFOLIA, Hochst. Taita.
CUPANIA? (Too young.) Kilima-njaro, 2000–3000 ft.
RHUS VILLOSA, L. f., forma parvifolia. Kilima-njaro, 2000–3000 ft.
RHUS GLUTINOSA, Hochst.

A form with panicles $\frac{1}{2}$–$\frac{2}{3}$ ft. long, slightly overtopping the leaves; the inflorescence more loosely pilose-pubescent than usual. Kilima-njaro, 6000 ft.

RHUS GLAUCESCENS, Rich., forma. 40–60 miles from coast and Kilima-njaro, 5000 ft.
AGELÆA LAMARCKII?, Planch. (in fruit). Plains up to 6000–7000 ft.
ADENOCARPUS MANNII, Hook. 6000–9000 ft.
PAROCHETUS COMMUNIS, Ham. 9000 ft.
TRIFOLIUM SUBROTUNDUM, Steud. & Hochst. 5000 ft.

TRIFOLIUM JOHNSTONI, Oliv., sp. nov. (§ Repentes). Herba perennis repens glabrata, foliis longe petiolatis membranaceis obcordato-cuneatis obtuse denticulatis nerviis utrinque 10–12, stipulis membranaceis apice liberis, pedunculis elongatis folio longioribus, capitulis multifloris globosis, floribus brevissime pedicellatis, calyce membranaceo, dentibus anguste subulatis anticis tubo paullo longioribus, corolla calyce fere duplo longiore, vexillo obovato-oblongo retuso sessile, ovario bi-ovulato.

Kilima-njaro, 10,000 ft.

Petioli 3–5 poll. longi; stipulæ $\frac{3}{4}$–1 poll. longæ. Foliola $\frac{2}{3}$–1 poll. longa, $\frac{2}{3}$–$\frac{3}{4}$ poll. lata. Pedunculi 5–8 poll. longi. Capitula $\frac{3}{4}$–1 poll. diam.; flores $\frac{1}{2}$ poll. longi.

With the general aspect of *Trifolium repens*, and near to *T. Burchellianum* in floral structure, but the leaflets are not closely nervose.

TRIFOLIUM POLYSTACHYUM, Fres. Kilima-njaro, 5000 ft.
INDIGOFERA, an *I. macrophylla*, Schum. & Thonn.? (Baker in Fl. Trop. Afr.).
INDIGOFERA ARRECTA, Hochst. Kilima-njaro, 4000–5000 ft.
INDIGOFERA PENTAPHYLLA, L. Kilima-njaro, 2000–3000 ft.
TEPHROSIA VOGELII, Hook. f. 40–60 miles inland.

ORNITHOPUS CORIANDRINUS, Hochst. (*Antopetitia abyssinica*, A. Rich. Fl. Abyss. i. 209, tab. 39). 6000 ft.

Not identifying this at first, I gave it the MS. name of *Hormolotus Johnstoni*, which appears in Mr. Johnston's 'Kilima-njaro Expedition,' pp. 337, 339, without description.

ÆSCHYNOMENE CRISTATA, Vatke? 40–60 miles inland.
ORMOCARPUM KIRKII, S. Moore. Kilima-njaro, 5000 ft.

Desmodium scalpe, DC. Kilima-njaro, 5000–6000 ft.

Desmodium oxybracteatum, DC. (*D. paleaceum*, Guill. & Perr.). Kilima-njaro, 5000–6000 ft.

Alysicarpus rugosus, DC.

Lathyrus, an *L. sativus*, L.? But stem angular, not alate; no fruit. 7000 ft.

Clitoria Ternatea, L. (forma minora). Kilima-njaro, 5000 ft.

Glycine javanica, L., forma? 7000 ft.

Dolichos Lablab, L. Kilima-njaro, 5000 ft.

Calpurnia aurea, Steud., var. major. Kilima-njaro, 6000 ft.

Cæsalpinia, sp. nov.?

In the absence of fruit better left unnamed. Unarmed, glabrate, or extremities and leaf-rhachis puberulous, varying to 5–6 in. in length; pinnæ 6–8-jugate; leaflets 14–18-jugate oblong obtuse mucronulate, almost veinless; stipellæ at base of pinnæ subulate spinescent. Flowers in a terminal dense spike overtopped by the leaves; calyx glabrous with oblong imbricate segments; petals venose obovate-rotundate, 6–8 lines long; stamens pilose below.

40–60 miles inland.

Pterolobium lacerans, R. Br. (*P. abyssinicum*, Rich.). 6000 ft.

Cassia didymobotrya, Fres. Kilima-njaro, 5000–6000 ft.

Cassia goratensis, Fres. 40–60 miles inland.

Cassia zambesiaca, Oliv. 40–60 miles inland.

Cassia mimosoides, L. 6000 ft.

Bauhinia tomentosa, L., var. parvifolia-hirtella. Kilima-njaro, 2000–3000 ft.

Bauhinia tomentosa, L., var. glabra. Maungu.

Bauhina reticulata, DC. (imperfect). Kilima-njaro, 5000 ft.

Acacia pennata, Willd. Kilima-njaro, 6000 ft.

Rubus dictyophyllus, Oliv., sp. nov. Pilosula eglandulosa, caule parce piloso-tomentello aculeato aculeis sparsis recurvis, foliis superioribus 3–1-foliolatis petiolatis aculeolatis, foliolis petiolulatis ovato-ellipticis acutis caudatis v. late rotundatis acute denticulatis, supra rugulosis sparse pilosulis subtus conspicue reticulatis parce pubescentibus, nervo medio aculeato, paniculis terminalibus multifloris, sepalis ovato-lanceolatis glanduloso-mucronatis utrinque tomentosis, petalis rotundatis calycem superantibus, carpellis (floriferis) parce pilosis, stylo glabro.

Kilima-njaro, 4000–10,000 ft.

Folia superiora, petiolo 1–$1\frac{1}{2}$ poll. longo, tenuiter pubescente, foliolo centrali $2\frac{1}{2}$ poll. longo, $1\frac{1}{2}$–$1\frac{3}{4}$ poll. lato; petiolulo $\frac{1}{2}$–$\frac{3}{4}$ poll. longo; foliolis lateralibus breviter petiolulatis. Flores $\frac{1}{2}$–$\frac{2}{3}$ poll. diam., breviter pedicellati; bracteæ lineari-lanceolatæ acutæ.

Brayera anthelmintica, DC., var. villosa. A tree of 25–30 ft. in height. The first time we have received this from outside Abyssinia. The stem and underside of sheathing petiole densely clothed with very tawny hairs. 7000–10,000 ft.

ALCHEMILLA ARGYROPHYLLA, Oliv., in Hook. Ic. Pl. t. 1505. Frutex stipulis vaginantibus exceptis sericeo-argenteus, ramis primariis elongatis ramulos breves numerosos axillares emittentibus, foliis breviter petiolatis tripartitis, lobo centrali late oblanceolato breviter trifido lobis lateralibus oblongis acutis, supra sericeis subtus pilis longis argenteis obsitis, stipulis vaginantibus membranaceis glabris castaneis margine pilis longis sparsis ciliatis, cymis 5–7-floris axillaribus pedunculo vaginato abscondito, floribus pedicellatis sericeis flavidis, carpellis 4.

Kilima-njaro, 8000–10,000 ft.

Folia $\frac{1}{2}$ poll. longa, lamina tripartita petiolo 3–4-plo longior. Stipulæ $\frac{1}{3}$–$\frac{1}{2}$ poll. longæ apice liberæ ovatæ obtusæ v. acutiusculæ. Pedicelli flores subæquantes. Perianthii tubus turbinatus, lobi exteriores lineari-lanceolati, interiores ovato-deltoidei.

With somewhat the habit of the Andine *A. polylepis*, Wedd., but with the small congested flowers emerging from the sheaths of nearly every axil on the lateral leafy shoots. The contrast between the silvery foliage and smooth chestnut-brown membranous, usually transversely rugose-plicate, stipules renders this one of the most striking species of the genus.

ALCHEMILLA JOHNSTONI, Oliv., in Hook. Ic. Pl. t. 1504. Fruticulus depressus, ramulis diffusis pilosulis vaginatis, foliis breviter petiolatis coriaceis rotundato-reniformibus plicatis 6- (5–7-) lobatis lobis obtusis bifidis, v. subæqualiter 11–15-lobatis, supra tenuiter pilosis glabratisve subtus dealbato-glaucis, pilis longiusculis sericeis sparsis obsitis, stipulis apice liberis coriaceis late ellipticis obtusis sæpius bidentatis, cymis pauci- (circ. 5-) floris pilosulis pedunculos breves vaginatos axillares folio sæpe longiores terminantibus, calycis tubo turbinato-infundibulari, carpellis solitariis.

Kilima-njaro, 13,000 ft.

Folia $\frac{1}{4}$–$\frac{1}{3}$ poll. lata; petiolus liber 1–2 lin. longus. Perianthii lobi interiores deltoidei, exteriores breviores lanceolati.

With wiry branches 3–6 in. in length, the thickness of a crow-quill, spreading from a woody crown.

TERMINALIA BROWNII, Fres. ? (no fruit). 2000–3000 ft.

COMBRETUM PANICULATUM, Vahl. (forma). 4000–5000 ft.

COMBRETUM, sp. (foliis hirtellis) (no fruit). 40–60 miles inland.

COMBRETUM, sp. (foliis lepidotis) (no fruit). 40–60 miles inland.

DISSOTIS EXIMIA, Hook. f. Kilima-njaro 5000 ft.

DISSOTIS, sp. aff. *D. grandifloræ*, Benth.

EPILOBIUM HIRSUTUM, L. 6000 ft.

WORMSKIOLDIA (STREPTOPETALUM HILDEBRANDTII, Vatke). Taita.

WORMSKIOLDIA SERRATA, Hochst. Maungu; Taita.

TRYPHOSTEMMA HANNINGTONIANUM, Mast. in Hook. Ic. Pl. t. 1484. Annua cirrifera scandens; foliis trisectis; floribus dichlamydeis; fructu subcoriaceo indehiscente.

In Africa tropica Orientali loco dicto "Kwa Chinopa" lat. aust. 2° 7′, ubi legit Rev. J. Hannington!; ad montem Kilma-njaro prope Maungu, alt. 2000 ped., legit H. H. Johnston.

Annua gracilis glabra laxe divaricatim ramosa, ramis filiformibus striolulatis. Folia membranacea eglandulosa suborbicularia 3-secta, segmentis oblongis vel obovato-oblongis acuminatis, basi remote glanduloso-serratis, segmento medio parum productiore versus basin angustato. Petioli graciles eglandulosi laminis breviores. Stipulæ lineari-subulatæ deciduæ. Pedunculi folia superantes apice 3-brachiati ramis lateralibus horizontaliter patentibus uno vel geminis fertilibus, centrali in cirrum producto. Bracteæ minutissimæ. Flores diametro 1 cm. patelliformes. Tubus brevissimus. Sepala herbacea oblonga obtusa ad margines albida. Petala albida membranacea sepalis conformia iisque paullo minora. Corona 3-seriata, series extima vel faucialis basi breviter tubulata membranacea, margine filamentosa filis crassiusculis basi retrorsum uncinulatis petala subæquantibus. Corona secunda e tubo versus medium emergens annularis seu cupuliformis membranacea integra; corona tertia seu basilaris e fundo tubi progrediens præcedenti conformis. Stamina 5 perigyna, filamenta e corona basilari emanentes; antheræ lineari-oblongæ. Ovarium ovoideum brevissime stipitatum, stipite tamen ulterius producto. Fructus ovoideus glaber subcoriaceus, stylis 3 liberis superatus. Stigmata capitatella. Semina . . . . . .

A curious and interesting plant having exactly the habit and general appearance of a *Passiflora*; but apart from the improbability of a true *Passiflora* being found in tropical Africa, the arrangement of the corona and the insertion of the stamens are those of the East-African genus *Tryphostemma*. There are, however, five petals in the present plant, and the fruit is apparently not dehiscent, though its appearance is such as to suggest that it may be. It is probable, as previously suggested, in the 'Flora of Tropical Africa,' that the two genera, the Eastern *Tryphostemma* and the Western *Basananthe*, will be found to be identical.—M. T. Masters.

Momordica cardiospermoides, Klotzsch. 40–60 miles inland.
Momordica cucullata, Hook. f., an var. *M. Morkorra*? Kilima-njaro, 4000–5000 ft.
Cephalandra quinqueloba, Sch., forma? Kilima-njaro, 5000 ft.
Zehneria scabra, Sond., var.? Kilima-njaro, 6000 ft.
Begonia, sp. (frequent).

Begonia Johnstoni, Oliv., sp. nov. Herba succulenta, glabra, 1–2-pedalis, foliis (sicca membranaceis) longe petiolatis ovatis basi cordatis valde obliquis breviter acuminatis inæqualiter crenato-dentatis basis annulatim et subtus sparse in nervis pilis setiformibus instructis, stipulis ovatis membranaceis, cymis axillaribus bisexualibus longe pedunculatis, bracteis geminatis brevibus ovatis acutis, pedicellis gracilibus florem subæquantibus, fl. ♂ lobis 4 subæqualibus obovatis pallide roseis, filamentis a basi liberis, antheris ellipticis inappendiculatis; fl. ♀ lobis 4 obovatis v. obovato-ellipticis, stylis 3 inferne coalitis ramis bifidis spiraliter tortis, placentis bifidis, capsula trialata, ala una majore oblique producta ovato-oblonga venosa.—Bot. Mag. t. 6899.

Kilima-njaro, 5000–6000 ft.

Folia $3\frac{1}{2}$–$4\frac{1}{2}$ poll. longa, 2–$2\frac{3}{4}$ poll. lata; petiolus 2–5 poll. longus. Pedunculi 5–8 poll. longi. Flores 1–$1\frac{1}{3}$ poll. Capsulæ ala producta $\frac{1}{2}$–$\frac{3}{4}$ poll.

The same plant has flowered at Kew, communicated by Mr. Mitten, who raised it from seed brought home by Bishop Hannington.

MOLLUGO NUDICAULIS, Lam. 40–60 miles inland.

SANICULA EUROPÆA, L. 10,000 ft.

TRACHYDIUM ABYSSINICUM, Benth. & Hook. f. 12,000 ft.

PEUCEDANUM, aff. *P. Petitianæ*, Rich.? 7000 ft.

PEUCEDANUM, sp. (no fruit). Kilima-njaro, 5000 ft.

CAUCALIS INFESTA, Curt.? (no fruit). 5300–6000 feet.

CAUCALIS MELANANTHA, Benth. & Hook. f. 6000 ft. Also four other Umbelliferæ, not in a state for determination.

DIRICHLETIA, near *D. glaucescens*, Hiern (in fruit only). Kilima-njaro, 2000–3000 ft.

PENTANISIA OURANOGYNE, S. Moore. Kilima-njaro, 2000–3000 ft.

PENTAS MOMBASSANA, Hiern, var. HIRTELLA. Maungu.

PENTAS CARNEA, Benth. Kilima-njaro, 5000–6000 ft.

PENTAS PURPUREA, Oliv. Kilima-njaro, 5000 ft.

PENTAS PURPUREA, Oliv., var.? LONGIFLORA. Kilima-njaro, 4400 ft.

PENTAS LONGIFLORA, Oliv., sp. nov. Erecta verosimiliter 2–3-pedalis hirtella, foliis lineari-lanceolatis acuminatis basi angustatis breviter petiolatis remote penniveniis, utrinque breviter hirto-tomentellis, cymis multifloris terminalibus v. etiam in axillis superioribus pedunculatis hirtis, floribus congestis, calycis setulosi lobis subulatis tempore florifero subæqualibus v. lobis 1–2 paullo majoribus subulatis tubo longioribus, corollæ hirtellæ elongatæ tubo apicem versus dilatato, limbo 5-partito, lobis ellipticis apice subapiculatis intus glabris, fauce barbato, stylo exserto lobis brevibus crassiusculis ovoideis obtusis.

Kilima-njaro, 5000 ft. (Lower plateau N. of Lake Nyassa, *Mr. Thomson.*)

Folia $2\frac{1}{2}$–4 poll. longa, $\frac{1}{3}$–$\frac{3}{4}$ poll. lata; petiolus 1–2 lin. longus. Calyx (temp. florif.) $\frac{1}{4}$ poll. longus. Corolla $1\frac{1}{2}$–$1\frac{3}{4}$ poll. longa.

OLDENLANDIA, an *O. Bojeri*, Hiern, var.? Maungu.

OLDENLANDIA SCHIMPERI, T. And., forma. Taveita and 40–60 miles inland.

OLDENLANDIA OBTUSILOBA, Hiern. Kilima-njaro, 5000 ft.

OLDENLANDIA HEYNEI, Wight & Arn. 4400 ft.

HEDYOTIS JOHNSTONI, Oliv., sp. nov. Suffruticosa diffusa ramosa glabrata v. scaberula, caulibus gracilibus glabris leviter angulatis, foliis ovatis v. ovato-lanceolatis acutis basi rotundatis remotiuscule penniveniis, supra parce scaberulis glabrisve breviter petiolatis, stipulis setaceo-paucilobatis, cymis parvis sæpius 3-fidis terminalibus

v. in axillis superioribus pedunculatis subsessilibusve, floribus 4–5-meris congestis sessilibus v. breviter pedicellatis, calycis subglabri tubo campanulato lobis subulato-lanceolatis 1-costatis tubum excedentibus, corolla extus glabra intus parce pilosula tubo calycem æquante, lobis tubo longioribus oblongis subapiculatis marginibus deinde revolutis, antheris subsessilibus, stigmate (exserto) bifido lobis linearibus.

Kilima-njaro, 6000 ft.

Folia $\frac{3}{4}$–$1\frac{1}{2}$ poll. longa, $\frac{1}{3}$–$\frac{3}{4}$ poll. lata. Inflorescentia $\frac{1}{3}$–$\frac{3}{4}$ poll. diam., pedunculo 0–1 poll. longo. Flores $\frac{1}{6}$–$\frac{1}{5}$ poll. longi.

EMPOGONA KIRKII, Hook. f., var. ? GLABRATA; ramulis ultimis hirto-scabridis, foliis ellipticis acutis retusisve fere omnino glabris, petiolis hirtellis, floribus glabrescentibus.

40–60 miles inland.

This may prove a distinct species; but our type specimen is imperfect and it may be better left as above, notwithstanding the pubescent-tomentose leaves, pedicels, and calyx of Sir J. Kirk's plant.

PAVETTA OLIVERIANA, Hiern. Kilima-njaro, 6000 ft.

PAVETTA (fruit) near *P. gracilis*, Klotzsch, and *P. caffra*, Thbg. 40–60 miles inland.

VANGUERIA EDULIS, Vahl, var.? Differs from our numerous specimens of this wide-spread species in the linear-oblong lobes of the calyx, 2–3 times as long as the tube, nearly equalling the corolla-tube; the cymes also are more contracted.

Kilima-njaro, 4000–5000 ft.

VANGUERIA EUONYMOIDES, Schw. Kilima-njaro, 5000 ft.

OXYANTHUS GERRARDI, Sond., var. floribus paullo majoribus, aff. *O. specioso*, DC. Kilima-njaro, 6000 ft.

POLYSPHÆRIA MULTIFLORA, Hiern. Kilima-njaro, 2000–3000 ft.

PSYCHOTRIA, near *P.* (*Grumilea*) *capensis*, Sond.? Kilima-njaro, 6000 ft.

PSYCHOTRIA HIRTELLA, Oliv., sp. nov. Breviter hirtella, foliis ellipticis obtusis v. breviter apiculatis basi sæpius cuneatim angustatis utrinque hirtellis venis secundariis remotiusculis, petiolatis, stipulis membranaceis hirtis truncatis medio apiculo subulato bipartito breviter productis, paniculis terminalibus v. quasi axillaribus longe pedunculatis divaricatim trichotomiis plus minus pubescentibus, floribus 5-meris pedicellatis, pedicello sæpius flore brevioribus, calyce turbinato truncato leviter 4–5-lobato, corollæ glabræ lobis ovato-ellipticis recurvis tubo brevioribus.

Kilima-njaro, 2000–3000 ft.

Folia 4–5 poll. longa, 2–$3\frac{1}{4}$ poll. lata; petiolus $\frac{1}{4}$–$1\frac{1}{4}$ poll. longus. Pedunculus 1–4 poll. longus.

Spermacoce Ruelliæ ?, DC. 4400 ft.

Galium Aparine, L. 8000 ft.

Dipsacus pinnatifidus, Steud. 10,000 ft.

Scabiosa Columbaria, L., var. ? 10,000–12,000 ft.

Valeriana, sp. nov. ? (Genus new to Trop. Africa.) Only a single flowering specimen, insufficient for description. 10,000 ft.

Vernonia Wakefieldii, Oliv., sp. nov. Frutex (?) glaber, ramulis floriferis inferne leviter incrassatis teretibus, foliis ovalibus oblanceolatisve acutis v. acuminatis basi in petiolum angustatis glabris tenuiter carnosulis v. subcoriaceis, cymis corymbiformibus 5–20-cephalis, capitulis pedunculatis campanulatis multifloris, involucri bracteis brunneis pluriseriatis imbricatis ovato-oblongis obtusis glabratis exterioribus minoribus pilis flaccidis albis ciliatis, receptaculo nudo, corollæ segmentis linearibus, ovario dense piloso, pappo pluriseriato fusco setaceo, setis barbellatis exterioribus brevioribus, acheniis . . . .

Kilima-njaro, 2000–3000 ft. (Gathered also in Nyika Country by Rev. T. Wakefield.)

Folia $2\frac{1}{2}$–5 poll. longa, $\frac{2}{3}$–$1\frac{1}{2}$ poll. lata. Inflorescentia 2–3 poll. diam. Capitulis floriferis, $\frac{3}{4}$ poll. longis.

Vernonia (§ Stengelia) stenolepis, Oliv., sp. nov.; ramis floriferis herbaceis striatis crispule pubescentibus, foliis tenuiter membranaceis ellipticis ovalibusve acute acuminatis basi in petiolum longiusculum attenuatis serrulato-dentatis utrinque pilis sparsis hirtis, capitulis late campanulatis pedunculatis in cymis 3–5-cephalis terminalibus dispositis, involucri squamis exterioribus e basi incrassata coriacea in appendicem elongatam anguste linearem v. spathulatam herbaceam v. purpureo tinctam flores æquantem productis, squamis interioribus brevioribus tenuiter coriaceis oblongis apiculatis pappo æquilongis, corollæ tubo gracili apice dilatato, acheniis striatis breviter piloso-hirsutis, pappi duplicis setis exterioribus brevibus squamiformibus, interioribus barbatis.

Kilima-njaro, 5000 ft.

Folia 4–6 poll. longa, 1–2 poll. lata; petiolus $\frac{1}{3}$–1 poll. longus. Capitula poll. diam.; pedunculus $\frac{1}{2}$–1 poll. longus.

Vernonia marginata, Oliv. & Hiern. "Up to 8000 ft."

Vernonia, aff. *V. paucifloræ*, Less. ?, an var. ? 6000 ft.

Vernonia, = V. 2551, Hb. Hildebrandt. 6000 ft.

Adenostemma viscosum, Forst. Kilima-njaro, 6000 ft.

Mikania scandens, Willd. 6000 ft.

Dichrocephala chrysanthemifolia, DC. 12,000 ft.

Felicia abyssinica, Sch. Bip. Taita; Maungu.

Conyza stricta, Willd. Kilima-njaro, 5600 ft.

Conyza ægyptiaca, Ait. Kilima-njaro, 5600 ft.

Conyza Hochstetteri, Sch., forma. Kilima-njaro, 5600 ft.

PLUCHEA DIOSCORIDIS, DC., var. GLABRA. Kilima-njaro, 5600 ft.

PSIADIA, sp. nov. ? 6000 ft.

ACHYROCLINE HOCHSTETTERI, Sch. Kilima-njaro, 6000 ft.

GNAPHALIUM LUTEO-ALBUM, L. 6000 ft.

HELICHRYSUM NEWII, Oliv. & Hiern. 13,200–14,200 ft.

HELICHRYSUM ELEGANTISSIMUM, DC., var. ? (*H. formosissimum*, Sch. Bip., var. *angustifolia*). 9000–11,000 ft.

HELICHRYSUM FORMOSISSIMUM, Sch. Bip., var. ? With the facies of *H. adenocarpum*, DC., but the ovaries are glabrous. 8000–13,000 ft.

HELICHRYSUM FORMOSISSIMUM, var. *capitulis albis*. 10,000 ft.

HELICHRYSUM KILIMANJARI, Oliv., sp. nov.; caulibus gracilibus adscendentibus v. erectis subteretibus glanduloso-puberulis, foliis caulinis anguste linearibus acutiusculis amplexicaulibus supra v. utrinque glanduloso-puberulis subtus plus minus laxe villoso- v. arachnoideo-tomentosis, capitulis homogamis hemisphæricis multifloris longiuscule pedunculatis in cymis laxis corymbiformibus 7–9-cephalis dispositis, involucri squamis pluriseriatis exterioribus brunneo tinctis ovatis acutiusculis, interioribus flavidis apice oblongo-lanceolatis acutis, receptaculo nudo areolato, corollis tubulosis coriaceis, acheniis minutis subteretibus v. obscure angulatis, pappo caducissimo barbellato.

Kilima-njaro, 8300 ft.

Caules $\frac{1}{2}$–1-ped. superne ramosi. Folia $\frac{3}{4}$ poll. longa, circ. 1 lin. lata. Capitula $\frac{1}{2}$ poll. diam.; pedunculi $\frac{1}{2}$–1 poll., graciles bracteati.

HELICHRYSUM GLOBOSUM, Sch. Bip., forma ? 10,000 ft.

HELICHRYSUM FRUTICOSUM, Vatke, var. 13,000 and 13,200 ft.

HELICHRYSUM ABYSSINICUM, Sch. Bip. 9000–11,000 ft.

HELICHRYSUM ABYSSINICUM, Sch. Bip., forma. 11,000–13,200 ft.

HELICHRYSUM SETOSUM, Harv. (*H. fœtidum*, Cass., var. ?). 9000–11,000 ft.

HELICHRYSUM KIRKII, Oliv. & Hiern, forma ?

Kilimanjaro, 6000 ft.

The capitula are rather too young, but probably of this species, which we have from various localities in the Eastern Tropical Highlands.

ASTEPHANIA, Oliv. in Hook. Ic. Pl. t. 1506. (Compositæ § Buphthalmeæ.)

Capitula heterogama homochroma radiata, floribus radii ♀ 1-seriatis discique ☿ fertilibus. Involucrum subhemisphæricum basi leviter intrusum, bracteis 2–3-seriatis herbaceis basi coriaceis subæqualibus. Receptaculum convexum paleis angustissimis flores subæquantibus onustum. Corollæ ♀ ligulatæ, lamina ovali-oblonga apice minutissime 3-denticulata v. integra; ☿ regulares tubo angusto sursum ampliato limbo breviter 5-dentato. Antheræ basi sagittatæ auriculis per paria connatis apice connectivo breviter ovato acuto apiculatæ. Styli fl. ☿ rami lineari-oblongi obtusi apice vix aut leviter subdilatati. Achænia leviter angulata apice truncata calva, basi subturbinato-angustata, glabra, valide 10-costata costis alternis interdum angustioribus.

Herba verosimiliter 2–3-pedalis pilis simplicibus multicellularibus laxe hirtella, caule erecto tereti superne ramoso. *Folia* caulina alterna petiolata late ovata basi cordata obtusa late crenato-lobulata laxe pilosula, 1–1½ poll. longa et lata. *Capitula* sæpe longe pedunculata terminalia solitaria v. in cymis pleiocephalis laxis disposita, ¾ poll. lata; floribus flavis, ligulis radii involucro duplo longioribus. *Achænia* ½–⅔ lin. longa.

A. AFRICANA, Oliv. *l. c.*

Kilima-njaro, 5000 ft.

With the habit of *Anisopappus africanus* or of some specimens of *Epallage dentata*, but wholly destitute of pappus. With this I would associate as a congener the plant figured in 'Icones Plantarum,' pl. 1451, as a doubtful *Sphacophyllum*; it will now stand A. AFRICANA.

MELANTHERA BROWNII, Sch., forma. Kilima-njaro, 6000 ft.

ASPILIA ? or WEDELIA, nr. *W. Menotriche* and *mossambicensis*. Kilima-njaro, 5000 ft.

ARTEMISIA AFRA, Jacq., forma. 9900–13,200 ft.

COREOPSIS, sp. nov. ? (inadequate). 4300 ft.

BIDENS PILOSA, L. 4000–6000 ft.

TRIPTERIS VAILLANTII ?, Decne. 4000 ft.

TRIPTERIS, sp. ? (too young). 8500 ft.

GYNURA CERNUA, Benth. 6000 ft.

GYNURA VITELLINA, Benth. Kilima-njaro, 6000 ft.

GYNURA VALERIANA, Oliv. in Hook. Ic. Pl. t. 1507. Perennis erecta (1½–2-pedalis), caule 5-sulcato glabro basi foliosis, foliis pinnatipartitis petiolatis membranaceis supra glabratis subtus parce pilosulis glabratisve, segmentis lateralibus utrinque 5–6 lanceolatis acutis grosse serrato-incisis dentibus acutis, segmentis inferioribus minoribus ovatis v. ovato-lanceolatis, petiolo basi biauriculato, auriculis stipuliformibus ½-cordatis incisis, foliis superioribus minoribus remotiusculis, capitulis circ. 40-floris discoideis pedicellatis in corymbo terminali polycephalo dispositis, pedicellis gracilibus puberulis, bracteis anguste linearibus, involucro cylindrico 11–15-phyllo, foliolis lineari-oblongis acutatis glabris dorso longitudinaliter 2–3-nervosis, calyculi foliolis brevibus lineari-subulatis, corollis omnibus tubulosis flavis, tubo elongato angusto involucrum subæquante basi leviter dilatato apice gradatim infundibuliformi, styli ramis in appendicibus elongatis angustis papillosis abeuntibus, acheniis circ. 10-costatis glabris.

Kilima-njaro, 5000 ft.

Folia inferiora 5–7 poll. longa, segmentis majoribus 1-1½ poll. longis, ½–⅔ poll. latis. Inflorescentia corymbosa, 3–4 poll. lata. Capitula ½ poll. longa; involucrum ¼–⅓ poll. longum.

Cineraria abyssinica, Sch. Bip., forma. 7000–10,000 ft.; barren, 13,200 ft.

Senecio discifolius, Oliv. 5000 ft.

Senecio deltoideus ?, Less., var. 6000 ft.

Senecio Johnstoni, Oliv., sp. nov. (Plate LX.) Arbuscula 15–20(–30)-ped., caule simplici erecto apice foliis amplis petiolatis indivisis congestis coronato, foliis late ovato-ellipticis obtusissimis basi cordatis dentatis membranaceis supra parce pilosulis glabratisve subtus præcipue in costa venisque plus minus pilosulis v. sublanatis, petiolo marginato lamina breviore, ramulis floriferis ($\frac{1}{2}$–$1\frac{1}{2}$-pedalis) lateralibus bracteatis, bracteis amplis oblanceolato- v. lanceolato-oblongis amplexicaulibus acutatis v. superioribus minoribus acuminatis pilosis glabratisve, capitulis heterogamis majusculis campanulatis v. hemisphæricis multifloris in paniculis ovoideis v. pyramidalibus lanatis v. inferne glabratis dispositis, pedicellis $\frac{1}{4}$–$\frac{1}{2}$–2 poll. longis apice deinde recurvis, involucri foliolis 13–20 oblongo-lanceolatis acutatis glabratis v. basi leviter lanatis pilosulisve, calyculi foliolis anguste linearibus, floribus radii circ. 10–16, ligula lineari involucro duplo longiore, fl. disci tubo superne cylindrico-dilatato inferne breviter angustiore, styli ramis deinde recurvis truncatis, acheniis glabris longitudinaliter costatis.

Kilima-njaro, 8500–14,000 ft.

Folia 12–15 poll. longa, 8–9 poll. lata; petiolus 3–4 poll. longus. Inflorescentia $\frac{3}{4}$–$1\frac{1}{2}$-pedalis; capitula $\frac{3}{4}$–1 poll. lata; bracteæ inferiores 3–6 poll. longæ.

This noble addition to the genus *Senecio* Mr. Johnston found growing by mountain streams, first appearing at 8500 feet. We have two specimens—one in early flower, in which the inflorescence is glabrate and the capitula campanulate, with about 13 involucral scales; the other lanate, with larger hemispherical capitula, their pedicels at length recurved and with about 20 involucral bracts. In habit this species approaches *S. gigas*, Vatke, of Abyssinia, but with very much larger capitula and undivided leaves.

Notonia abyssinica, A. Rich. 40–60 miles inland.

Euryops dacrydioides, Oliv. in Hook. Ic. Pl. t. 1508. Frutex ramosus, ramulis strictiusculis erectis dense foliosis, foliis crassiusculis rigidis lineari-subulatis acutiusculis semiteretibus subarcte imbricatis marginibus infra plus minus lanato-villosis, capitulis versus apices ramulorum dispositis breviter pedunculatis, involucri foliolis circ. 13–17 oblongo-lanceolatis obtusis v. acutiusculis glabris, ligulis 16–18 ovali-oblongis involucro 2–3-plo longioribus flavis, receptaculo foveolato, foveolis dentato-marginatis, pappo caducissimo setoso setis barbellatis, acheniis 6-costatis glabris.

Kilima-njaro, 10,000–14,000 ft.

Folia $\frac{1}{6}$–$\frac{1}{4}$ poll. longa. Capitula $\frac{3}{4}$ poll. diam.; involucrum $\frac{1}{4}$–$\frac{1}{3}$ poll. diam.

In habit resembling *E. Candollei*, Harv., of the Cape.

Gazania diffusa, Oliv., sp. nov. (Plate LXI.) Herba annua (v. interdum perennis ?), caulibus diffusis parce setosis foliosis, foliis inferioribus radicalibusque lineari-ovalibus v. anguste ovalibus integris v. utrinque 1–3-pinnatim lobatis, caulinis linearibus sessilibus subacutis omnibus subtus albo-tomentosis supra setaceo-hispidis v. scabris, capitulis solitariis terminalibus pedunculatis, involucro setuloso tomentello campanulato-obconico, bractearum apicibus liberis lineari-subulatis erectis medio costatis, acheniis clavato-turbinatis obscure 10-costatis glandulis sessilibus pilisque albidis erectis obsitis, pappo duplici paleis exterioribus 10 ovato-lanceolatis aristato-acuminatis, interioribus brevioribus ovatis fimbriatis subunguiculatis.

Kilima-njaro, 5000 ft.

I think our imperfect specimens of Hildebrandt's no. 2701, belong to the same, as well as a single specimen collected by Speke and Grant, which I left unnamed in Trans. Linn. Soc. xxix. p. 100.

The pappus is dimorphic, as in the above, in *G. Burchelli*, of South Africa.

Erythrocephalum minus, Oliv. 40–60 miles inland.

Carduus leptacanthus, Fres. Kilima-njaro, 6000 ft.

Carduus, an acaulescent species allied to *C. chamæcephalus*, Oliv. & Hiern, but with involucral bracts pinnately fimbriate above. 13,200 ft.

Gerbera piloselloides, Cass. Kilima-njaro, 4000–5000 ft.

Sonchus, a species new to Tropical Africa, with petiolate, elliptical, acute, denticulate leaves and capitula lanate below, in a few-headed congested cyme. A single specimen 6–9 in. high.

Lobelia Deckenii, Hemsl. (*Tupa Deckenii*, Asch.). 12,000–13,000 ft.

Lightfootia abyssinica, Hochst., forma. 6,000 ft.

Wahlenbergia, sp. n.? Without fruit. Allied to *W. capillacea*, A. DC., of the Cape. 11,000 ft.

Erica arborea, L., forma. 10,000 ft.

Blæria spicata, Hochst. 8,000–11,000 ft.

Ericinella Mannii, Hook. f. 7,000–10,000 ft.

I cannot doubt the identity of this with the Cameroons plant, but I find the flowers trimerous, stamens 6, and ovary trilocular. Mr. Johnston describes it as a "tall tree, twenty to twenty-five feet in height."

Plumbago zeylanica, L. 40–60 miles inland.

Lysimachia, an *L. Ruhmerianæ*, Vatke, var.?, racemis fructiferis elongatis gracilibus. 5300 ft.

Euclea fruticosa, Hiern, ? ♂. Kilima-njaro, 6000 ft.

Landolphia florida? Inflorescence only. Country at base of Kilima-njaro, 2000 ft.

Landolphia Petersiana, Dyer. Kilima-njaro, 2000 ft.

Adenium speciosum, Fenzl, forma? 40–60 miles inland.

Gomphocarpus bisacculatus, Oliv., sp. n. Herba erecta hispidulo-hirta verosimiliter 2–3-pedalis, caule tereti hispidulo, foliis petiolatis oblongis v. interdum lanceolato-oblongis obtusis interdum apiculatis basi rotundatis obtusis utrinque hispidulo-hirtis v. pagina sup. scabrida venis lateralibus subtus patentibus in vena intramarginali confluentibus, cymis umbelliformibus 4–8(–10)-floris extra-axillaribus longiuscule pedunculatis hispidis, calycis lobis oblongo-lanceolatis acutis hispidis, corollæ lobis ovatis extus hirtis marginibus anguste imbricatis calyce duplo longioribus, lobis coronæ gynostegio brevioribus complicatis medio apiculatim productis lateribus apice utrinque depresso-sacculatis, membrana antheræ terminali late ovata incurva.

Kilima-njaro, 5000 ft.

Folia 3–4 poll. longa, $\frac{3}{4}$–1 (–1$\frac{1}{2}$) lata; petiolus $\frac{1}{4}$ poll. longus. Pedunculi 2–3 poll. longi, bracteolis anguste linearibus; pedicelli $\frac{1}{2}$–$\frac{3}{4}$ poll. longi. Corolla $\frac{3}{4}$–1 poll. diam., sicco purpureo-reticulata.

Very similar, if not identical, are specimens from Zambesia, *Sir J. Kirk*; Nyika Country, *Rev. T. Wakefield*; and Mombassa, *Hildebrandt*, no. 1943.

Gomphocarpus stenophylla, Oliv. Lanjora, 2000 ft.

Mr. Johnston's specimens are in much better state than those I had at my disposal in the Speke and Grant collection; but I can hardly doubt they belong to the same species, although in the new specimens the lobes of the corona much overtop the stigma.

Gomphocarpus, aff. *G. lanato* et *G. stenophyllo.* 2300 ft.

Schizoglossum (Lagarinthus), sp. Maungu, 2000 ft.

With the facies of *Lagarinthus abyssinicus*, Hochst., and also of *L. interruptus*, E. Mey., the floral structure of which latter is nearly identical, though the appendix of the coronal scales is rather shorter. Perhaps specifically distinct.

Asclepias macrantha, Hochst. Kilima-njaro, 5000 ft., and Taita, 2000 ft.
Margaretta rosea, Oliv. Kilima-njaro, 5000 ft.
Cynanchum abyssinicum, Decne., var. ? tomentosum. 7000 ft.
Ceropegia, sp. nov., aff. *C. Meyeri*; diff. corollæ ore, &c. Kilima-njaro, 6000 ft.

Gymnema parvifolium, Oliv., sp. nov. Frutex volubilis glaber, ramis gracilibus teretibus, foliis ellipticis acutis v. obtusis apiculatisque glabris penniveniis petiolatis, cymis glabris v. obsolete pubescentibus breviter pedunculatis paucifloris axillaribus, pedicellis flore æquilongis, calycis lobis ovatis obtusis ciliolatis, corollæ lobis calyce 3–4-plo longioribus ellipticis obtusis, corona 0, stigmate breviter columnari-conico producto glabro.

Kilima-njaro, 5000 ft.

Folia $\frac{3}{4}$–$\frac{5}{6}$ poll. longa, 5–6 lin. lata; petiolus $\frac{1}{2}$–1 lin. longus. Cymæ axillares v. ad apicem ramulorum 2–4 congestæ, sæpius umbelliformes; pedunculus 1–4 lin. longus. Corolla rotata, 2 lin. diam.

Swertia Schimperi, Griseb. 8000–11,000 ft.
Swertia pumila ?, Hochst. 11,000 ft.
Ehretia amœna, Klotzsch. ? 40–60 miles inland.

Heliotropium, sp. nov.? (cf. Hildebrandt, 2634), aff. *H. longifloro* et *Steudneri*. 40–60 miles inland.

Cynoglossum micranthum, Desf. (*C. lanceolatum*, Fres.). Kilima-njaro, 6000 ft.

Cynoglossum amplifolium, Hochst. (*C. lancifolium* ?, Hook. f.). 9900 to 11,000 ft.

Myosotis stricta, Link. (The plant of Abyssinia and the Cameroons.) Var. nucibus nigrescentibus. 13,200 ft.

Ipomœa bullata, Oliv., sp. nov. (Plate LXII.); caule subtereti striato parce hirtello, foliis petiolatis subpinnatim palmatipartitis segmentis 8–10 linearibus oblongisve obtusis acutisve margine undulatis profunde bullatis supra glabratis subtus præcipue in nervis tomentellis v. interdum glabratis, cymis paucifloris axillaribus breviter pedunculatis, pedicellis calycem æquantibus, sepalis subæqualibus ellipticis obtusis interdum mucronatis, corollæ purpureæ tubo cylindrico calycem 4–5-plo longiore, limbo explanato.

40–60 miles inland.

Folia 3–5 poll. longa, 5–6 poll. lata, lobis $\frac{1}{4}$–$\frac{3}{4}$ poll. latis; petiolus $1\frac{1}{2}$–$3\frac{1}{2}$ poll. longus. Pedunculi petiolo sæpius breviores. Calyx $\frac{2}{3}$–$\frac{3}{4}$ poll. longus. Corolla 3 poll. longa.

Leaves of the same were collected from the only plant observed by Col. Grant, noticed in the account of his collections in Trans. Linn. Soc. xxix. p. 117.

Ipomœa pinnata, Hochst. Kilima-njaro, 5000 ft.

Ipomœa, sp.? (too imperfect). 6000 ft.

Cuscuta (§ Grammica) Kilimanjari, Oliv., sp. nov.; caule filiformi, floribus breviter pedicellatis sæpe racemosim umbellato-glomeratis glabris ($\frac{1}{6}$–$\frac{1}{4}$ poll. diam.), calyce 6-fido tenuiter coriaceo, lobis rotundatis obtusis, corolla campanulata flavida, tubo calyce subæquilongo prope basin lobis opposito transverse sacculato v. foveolato, lobis ovato-rotundatis obtusis, staminibus in sinubus inserta, filamentis anguste linearibus basi breviter dilatatis inappendiculatis, stylis paullo inæquilongis ovario brevioribus, stigmatibus capitatis, capsula verosimiliter basi dehiscentia circumscissa.

Kilima-njaro, 6000 ft.

The "epistamineal scales" of Engelmann are wanting in this species; there is, however, a crescentic transverse sacculus near the base of the corolla-tube, opposite to each lobe.

Solanum nigrum, L., var. 4400 ft.

Solanum, sp., apparently identical with a Natal species (Gerard 1413, Wood 559), and perhaps a form of *S. bifurcum*, Hochst. (Hb. Schimp. Abyss. 201 & 310 of the 1869 distribution).

Solanum Renschii, Vatke. Taveita.

Buttonia natalensis, McKen. Kilima-njaro, 5000 ft.

Veronica Anagallis, L. Kilima-njaro, 6000 ft.

Veronica myrsinoides, Oliv., in Hook. Ic. Pl. t. 1509. Perennis, caulibus prostratis elongatis parce aut vix ramosis foliatis bifariam pilosulis, foliis breviter petiolatis oppositis oblanceolatis obovato-oblongisve obtusis utrinque 2–3-crenato-dentatis glabris plus minus coriaceis, floribus in axillis foliorum superiorum pedicellatis, pedicellis glanduloso-pubescentibus calyce subæquilongis v. brevioribus, calyce 5-partito, lobo postico minuto cæteris oblanceolato-oblongis glanduloso-ciliatis, corolla pallide cærulea profunde 5-fida, lobis subæquilongis, postico cæteris obovatis integris paullo latiore late obovato, capsula obcordata lobis obtusis.

Kilima-njaro, 11,000 ft.

Folia $\frac{1}{4}$–$\frac{1}{3}$ poll. longa; petiolus 1 lin. v. brevior. Flores 3–4 lin. diam. Ovarium ellipsoideo-globosum apice parce glandulosum, glandulis stipitatis; stylus gracilis ovario 2-plo longior.

Allied to *Veronica glandulosa*, Hochst.

RHAMPHICARPA (sp. nov. ?).

Strigose herb, the lower leaves wanting, with elongate raceme of *Buchnera* or *Striga* and shortly pedicellate, "mauve-white" flowers; the limb 1 in. in diameter; calyx-lobes more or less recurved.

A single piece, barely sufficient for description. 4400 ft.

RHAMPHICARPA, sp. ? (no fruit). 40–60 miles inland.

BARTSIA DECURVA, Hochst., var. ? 12,000 ft.

OROBANCHE, sp. Kilima-njaro, 6000 ft.

STREPTOCARPUS, sp., aff. *S. caulescenti*, Vatke. 6000 ft.

STREPTOCARPUS MONTANUS, Oliv., sp. nov. Herba epiphytica acaulescens, foliis paucis (2–4) ovali-oblongis acutiusculis basi in petiolum angustatis serratis in utraque facie (supra appresse subtus præcipue in nervis) pilosulis, scapis gracilibus 1–3 pilosulis, cyma sæpius 3–10-flora, pedunculis gracilibus glanduloso-pilosulis, corolla inflato-tubulari v. tubulari-infundibuliforme, labiis vix patentibus, ovario glanduloso-pilosulo.

Kilima-njaro, 7000–9000 ft.

Folia 3–6 poll. longa, 1–$1\frac{1}{2}$ poll. lata. Scapus 5–8 poll. Flores purpurascentes, $\frac{1}{2}$ poll. longi; pedicelli inæquilongi, longiores, 3–6 lin. longi. Calyx 5-partitus, lobis oblongo-lanceolatis obtusiusculis hirtis. Corolla calyce 6-plo longior, basi leviter obliqua, bilabiata, labiis subporrectis, superiore paullo breviore, lobis obtusis. Capsula $\frac{3}{4}$–1 poll. longa.

With the general aspect of *S. parviflorus*, E. Mey., but corolla very different.

HEBENSTREITIA DENTATA, L. 9000–12,000 ft.

SELAGO THOMSONI, Rolfe. 11,000 ft.

SELAGO JOHNSTONI, Rolfe, n. sp. Annua, ramis erectis teretibus cinereo-pubescentibus, foliis linearibus obtusis integris scabridulo-pubescentibus margine subrevolutis, capitulis terminalibus in glomerulis sæpissime congestis, floribus sessilibus, bracteis oblongis obtusis crassiusculis concavis ciliatis, calyce irregulariter 5-fido pubescente lobis subulato-linearibus, corollæ tubo brevi lobis rotundato-oblongis tubo subæqualibus, staminibus styloque breviter exsertis, fructu ovoideo subcompresso in coccis 2 partibilis.

Kilima-njaro, 11,000 ped. alt. "Corolla pinkish."

Herba $\frac{1}{2}$ ped. alt. Folia 2–4 lin. longa, $\frac{1}{2}$ lin. lata, sæpissime fasciculata. Glomerula $\frac{1}{3}$–$\frac{1}{2}$ in. longa lataque. Bracteæ 1 lin. longæ. Calyx 1 lin. longus. Corolla $1\frac{1}{4}$ lin. longa. Fructus vix 1 lin. longus.

Closely allied to *S. Thomsoni*, Rolfe, from the same region, but somewhat stouter and dwarfer in habit, and readily distinguished by its more rigid fascicled and scabrid leaves, congested panicles, and slight floral differences. Both belong to a small group of which *S. hyssopifolia*, E. Mey., may be regarded as the type.—R. A. Rolfe.

Sesamum indicum, L. Kilima-njaro, 5000 ft.

Thunbergia affinis, var. pulvinata, S. M. Maungu.

Thunbergia fuscata ?, T. And. 6000 ft.

The flower is described as deep yellow; that of *T. fuscata* as pink.

Thunbergia. Fragments merely, but apparently a remarkable species of this genus with glabrous, rotundate-cordiform, petiolate leaves, and the multifid calyx with lanceolate acuminate segments growing out to $\frac{3}{4}$ in. in length.

Blepharis bœrhaavifolia, Juss. Maungu.

Blepharis, an var. *B. Hildebrandtii*, S. Moore. ? Maungu; Kilima-njaro, 2000–3000 ft.

Phaylopsis longifolia ?, Sims (T. And.). *Ætheilema imbricatum* (R. Br.). 5000 ft.

Phaylopsis longifolia. 6000 ft. (=Schimper, Abyss. Herb. 1523).

Mimulopsis, sp. ?, v. *Strobilanthes* ? 7000 ft.

Barleria, sp. ? 5300 ft.

Barleria, near *B. repens*, Nees. 40–60 miles inland.

Strobilanthes, sp. n. ? 6000–7000 ft.

Crossandra nilotica, Oliv., var. acuminata, Moore. (Species ut videtur distincta.) Lanjora; Kilima-njaro, 2000–3000 ft.

Asystasia Schimperi, T. And., var. minor. Kilima-njaro, 4000–5000 ft.

Justicia (Adhatoda) Schimperiana, T. And. Maungu.

Justicia (Rostellaria) palustris, T. And. ? Maungu.

Justicia plicata, Nees, var. ? Kilima-njaro, 6000 ft.

Justicia matamensis, Schweinf. Kilima-njaro, 5000–6000 ft.

Justicia matamensis, Schweinf., foliis angustioribus. 40–60 miles inland.

Justicia, aff. *J. neglectæ*, T. And. Kilima-njaro, 6000 ft.

Justicia debilis, Vahl. Maungu.

Justicia, sp. Near *J. insularis* and *neglecta*; with species gathered from 4400 to 6500 ft.

Justicia, sp. (inadequate). 7000 ft.

Isoglossa laxa, Oliv., sp. nov. Fruticosa, ramis gracilibus glabris (cystolithiis numerosis longitudinaliter dispositis quasi strigillosis), foliis petiolatis membranaceis ellipticis plus minus acuminatis basi in petiolum angustatis glabratis, paniculis terminalibus laxis pilosis pedunculis divergentibus, bracteis linearibus, floribus brevissime pedicellatis, calycis lobis anguste linearibus parce pilosis, corolla carnea pilosula bilabiata, tubo calyce duplo longiore, labio superiore bifido, inferiore trifido.

Kilima-njaro, 7000 ft.

Folia 2–3 poll. longa, 1–$1\frac{1}{2}$ poll. lata; petiolus $\frac{1}{3}$–2 poll. longus; folia superiora interdum subsessilia. Flores $\frac{1}{2}$–$\frac{2}{3}$ poll. longi.

Nearly allied to, if not identical with, a plant occurring on the Cameroons Mountain at 7000 ft. alt.

Brachystephanus, sp.? 7000 ft.

Anisotes parvifolius, Oliv., sp. nov. Ramis teretibus glabris cortice albido, foliis subcoriaceis oblanceolatis obovatisve acutiusculis v. obtusis basi in petiolum cuneatim angustatis glabris, floribus 2–4-nis fasciculatis subsessilibus ramulos brevissimos laterales terminantibus, calyce 5-partito lobis lanceolatis acutis appresse sericeis, corolla puberula v. glabrata, longissime bilabiata, labio postico bidentato, antico breviter 3-fido lobo centrali paullo latiore oblongo obtuso, antherarum loculis leviter obliquis basi mucronulatis.

Kilima-njaro Expedition, 40–60 miles inland.

Folia $\frac{3}{4}$–1 poll. longa, $3\frac{1}{2}$–5 poll. lata. Flores 2–$2\frac{1}{4}$ poll. longi; calyx 3–4 lin. longus; bracteæ sepalis conformes.

Rhinacanthus communis, Nees. 40–60 miles inland.

Hypoestes antennifera, S. Moore. Maungu; Kilima-njaro, 2000–3000 ft. and 6000 ft.

Lantana viburnoides, Vahl. 4400 ft.

Lantana Petitiana, Rich. ?, an *L. salvifoliæ* forma? Kilima-njaro, 6000 ft.

Lantana salvifolia, Jacq., var.? Kilima-njaro, 5000 ft.

Vitex chrysoclada, Boj. Kilima-njaro, 6000 ft.

Vitex, aff. *V. mombassæ*, Vatke, et *lanigeræ*, Sch. Kilima-njaro, 5000 ft.

Clerodendron Johnstoni, Oliv., sp. nov.; ramulis tomentellis, foliis longiuscule petiolatis ovato-ellipticis apiculatis obtusisve basi rotundatis v. late cuneatis supra pilis brevibus sparsis hirtis glabratisve subtus tomentosis, cymis multifloris terminalibus breviter pedunculatis corymbosim ramosis tomentosis, bracteis anguste linearibus, floribus breviter pedicellatis, calyce turbinato-campanulato 5-fido tomentoso lobis ovato-deltoideis acutis, corollæ tubo glabro calyce duplo longiore limbi lobis subæquilongis obovato- v. late ellipticis obtusis extus hirtis, filamentis exsertis.

Kilima-njaro, 5000 ft.

Folia $2\frac{1}{2}$–5 poll. longa, $1\frac{3}{4}$–3 poll. lata; petiolus $\frac{3}{4}$–$1\frac{1}{2}$ poll. longus. Inflorescentia 2–4 poll. lata. Flores $\frac{1}{2}$ poll. longi. Calyx $\frac{1}{4}$ poll. longus.

Clerodendron (Cyclonema), sp. nov.? Taita.

Differs from other named species in the Kew Herbarium with ternate, narrow, serrate-dentate leaves in the long slender tube of the corolla.

CLERODENDRON (CYCLONEMA) MYRICOIDES, Hochst., var.? Foliis verticillatis (3–4 poll.) grosse serratis subtus tomentosis, calyce hirsuto.

"Very common, reaches 7000 ft."

OCIMUM CANUM, Sims, var. Kilima-njaro, 2000–3000 ft.

OCIMUM GRAVEOLENS, A. Br.? Kilima-njaro, 6000 ft.

OCYMUM, sp. 6000 ft.

ORTHOSIPHON?, aff. *O. glabrato*, Benth.? (inadequate). 40–60 miles inland.

PLECTRANTHUS PARVUS, Oliv., sp. nov. Herba annua $\frac{1}{2}$–$\frac{3}{4}$-pedalis, caule erecto simplici v. inferne ramoso flaccide pilosulo, foliis longe petiolatis ovatis acutiusculis crenato-serratis petiolisque parce pilosis, racemis terminalibus laxe pilosis 1–2-uncialibus, bracteis parvis ovatis lanceolatisve pedicello brevioribus, verticillastris sexfloris, pedunculo brevissimo, pedicellis 1–1$\frac{1}{2}$ lin. longis, calycis lobis deltoideis lobo postico paullo latiore cum apiculo cæteris breviore, lobis anticis acuminatis, corollæ labio postico explanato, angulato-rotundato, antico cymbiformi postico vix longiore stamina inclusa vaginante, nucibus obovoideo-globosis lævibus.

Kilima-njaro, 5000 ft.

Folia 1–1$\frac{3}{4}$ poll. longa, $\frac{2}{3}$–1 poll. lata; petiolus $\frac{1}{2}$–1 poll. longus. Flores 4 lin. longi.

PLECTRANTHUS, aff. *P. glanduloso*, Hook. f. 6000 ft.

COLEUS UMBROSUS, Vatke. Taita.

PLATYSTOMA AFRICANUM, Beauv. Kilima-njaro, 5000–6000 ft.

MOSCHOSMA: M. MULTIFLORIS v. M. RIPARIÆ, var.? Kilima-njaro, 6000 ft.

ÆOLANTHUS ZANZIBARICUS, S. Moore. 40–60 miles inland.

HYPTIS PECTINATA, Poit. Kilima-njaro, 4000–5000 ft.

SALVIA NILOTICA, Vahl., var.? Kilima-njaro, 6000 ft.

MICROMERIA PUNCTATA, Benth. 4000 ft. A form found in the Cameroons, 7000–10,000 ft.

MICROMERIA, an *M. punctatæ* forma floribus cleistogamis? 6000 ft.

MICROMERIA ABYSSINICA, Benth., forma (flowers mauve). 4000–6000 ft.

TINNEA ÆTHIOPICA, Kotschy & Peyr., var. Kilima-njaro, 5000 ft.

TINNEA, sp., may be distinct. Kilima-njaro, 5000 ft.

With narrow oblanceolate-spathulate scabrid leaves, fascicled at the nodes, with two or three pedicellate flowers from each. A copiously flowering shrub, of which additional specimens are needed. *T. erianthera*, Vatke, I do not know; the anthers of our plant are barbate.

AJUGA REMOTA, Benth. Kilima-njaro, 5000 ft.

LEONOTIS. L. RUGOSÆ, Benth., var.? Kilima-njaro, 4000–5000 ft.

LEUCAS GLABRATA, Benth. Maungu and Kilima-njaro, 2000–3000 ft.

LEUCAS. L. GLABRATÆ, var.? 40–60 miles inland.

LEUCAS NEUFLIZEANA, Courb. Maungu, 2000 ft.

LEUCAS, sp. nov.? Taita; Maungu.

LABIATA (§ OCYMOIDEÆ), sp. 8000 ft.

PLANTAGO PALMATA, Hook. f. 7000 ft.

DIGERA ARVENSIS, Fres. 40–60 miles inland and Maungu.

PSILOTRICHUM AFRICANUM, Oliv., sp. nov. Frutex pubescens glabratisve, ramulis divaricatis gracilibus subteretibus, foliis oppositis ovato-lanceolatis ovatisve acutis basi late cuneatis rotundatisve minute pubescentibus glabratisve, spicis sæpius 5–15-floris brevibus axillaribus terminalibusque breviter pedunculatis v. subsessilibus, bracteis persistentibus ovato-lanceolatis acutis hirtis patentibus recurvisve, bracteolis late ovatis apiculatis scariosis perianthio dimidio brevioribus, perianthii segmentis ovato-lanceolatis concavis acutis coriaceis extus minute pubescentibus, filamentis angustis basi in annulum brevissimum coalitis, stigmate capitellato.

Kilima-njaro, 5000 ft. (Zambesi, *Sir J. Kirk*; Ribè, *Rev. T. Wakefield*).

Folia (in spp. Kilim.) $\frac{3}{4}$–$1\frac{1}{4}$ poll. $\times$ $\frac{1}{2}$–$\frac{3}{4}$ poll., (in spp. Zamb. et Ribè) $1\frac{1}{4}$–$3 \times \frac{2}{3}$–$1\frac{1}{2}$ poll.; petiolus 1–3 lin. longus. Spicæ $\frac{1}{2}$–$\frac{3}{4}$ poll. longæ; flores $\frac{1}{8}$–$\frac{1}{6}$ poll. longi.

PHYTOLACCA ABYSSINICA, Hoff. Kilima-njaro, 6000 ft.

CHENOPODIUM MURALE, L. Kilima-njaro, 5000 ft.

OXYGONUM (*Ceratogonum atriplicifolium*, Meiss.). Kilima-njaro, 6000 ft.

POLYGONUM BARBATUM, L. Kilima-njaro, 5000 ft.

POLYGONUM SENEGALENSE, Meiss. Kilima-njaro, 6000 ft.

POLYGONUM SERRULATUM, Lag. Kilima-njaro, 5000 ft.

RUMEX STEUDELII, Hochst. Kilima-njaro, 6000 ft. Same? (in fl.). Kilima-njaro, 13,000 ft.

RUMEX ALISMIFOLIUS, Fres. Kilima-njaro, 6000 ft.

PROTEA ABYSSINICA, Willd. 9000–13,000 ft. A leafy specimen of the same was collected some fourteen years ago by Mr. New.

ARTHROSOLEN LATIFOLIUS, Oliv., sp. nov. Frutex, ramulis gracilibus teretibus ultimis sericeo-pubescentibus mox sæpe glabratis, foliis alternis oblanceolato-oblongis obtusis basi angustatis tenuiter sericeis subglabrisve breviter petiolatis, floribus capitatis, capitulis terminalibus v. ramulos breves laterales foliosos terminantibus, involucratis, bracteis ovalibus sericeo-pubescentibus floribus paullo brevioribus deciduis, floribus 5-meris, tubo perianthii longe et dense villoso.

Kilima-njaro, 5000 ft. (Ribè to Galle Country, *Rev. T. Wakefield*).

Folia 1–$1\frac{3}{4}$ poll. longa, 3–5 lin. lata.

LORANTHUS CURVIFLORUS, Benth. 40–60 miles inland.

LORANTHUS, sp. (§ TAPINANTHUS, sed corolla basi haud dilatata). 4500 ft.

THESIUM, an *T. radicans*, Hochst.? 10,000–13,000 ft.

EUPHORBIA (§ TITHYMALUS), sp. 10,000 ft. Aspect of *E. depauperata*, Hochst., but too young.

EUPHORBIA, sp. (not in a state to describe). 7000 ft.

BRIDELIA MELANTHESOIDES, Klotzsch, forma. Kilima-njaro, 5000 ft.

PHYLLANTHUS MADERASPATENSIS, L. Kilima-njaro, 2000–3000 ft.

PHYLLANTHUS NIRURI, L., forma? Kilima-njaro, 5000 ft.

ANTIDESMA. A. VENOSUM, Tul., var.? 40–60 miles inland.

GELONIUM ZANZIBARENSE, Muell. Arg. 40–60 miles inland.

JATROPHA, sp. nov.? Leaves ovate elliptical serrulate, stipules partite in setaceous segments. 40–60 miles inland.

Not identified and probably new, but the material hardly sufficient for description.

CROTON PULCHELLUS, Baill.? 40–60 miles inland.

CROTON MACROSTACHYS, Hochst. Kilima-njaro, 5000–6000 ft.

ACALYPHA ORNATA, Rich., var. (*A. Livingstoniana*, Muell. Arg.?). Kilima-njaro, 6000 ft.

ACALYPHA, cf. *A. adenotricham*, Rich. Kilima-njaro, 6000 ft.

ACALYPHA PANICULATA, Miq. Maungu.

ACALYPHA, an aff. *A. fruticosæ*, Fres.? 5000 ft.

TRAGIA, an *T. mitis*, var.? (fruit). Kilima-njaro, 4000–5000 ft.

SPONIA BRACTEOLATA, Hochst.? Lanjora.

MORUS INDICA, Willd.? 40–60 miles inland.

PILEA JOHNSTONI, Oliv., sp. nov. Herba urticiformis, caulibus erectis glabris, foliis longe petiolatis ovatis obtusiuscule acuminatis basi sæpius late rotundatis grosse serratis supra parce subtus præcipue in nervis pilosulis, stipulis membranaceis intrapetiolaribus late ovatis rotundatisve, cymis axillaribus petiolo brevioribus pedunculatis androgynis, floribus sæpius capitatim congestis, fl. ♂ perianthii lobis 4 basi coalitis ovato-oblongis dorso sub apicem apiculato, fl. ♀ lobo majore achænium subæquante. Kilima-njaro, 5000 ft.

Herba verosimiliter $1\frac{1}{2}$–3 ped. Folia 2–3 poll. longa, $1\frac{1}{2}$–2 poll. lata; petiolus 1–$2\frac{1}{2}$ poll. longus. Cymæ cum pedunculo 1–$1\frac{1}{2}$ poll.

MYRICA, an *M. salicifoliæ* var., foliis oblongo-ellipticis obtusis? Kilima-njaro, 4000–5000 ft.

POLYSTACHYA KILIMANJARI, Reichb. fil. 40–60 miles inland.

VANILLA, sp? (frequent). 40–60 miles inland.

ANGRÆCUM EBURNEUM?, Thou. Kilima-njaro, 6000 ft.

EULOPHIA, sp. Maungu.

LISSOCHILUS, sp. 40–60 miles inland.

DISPERIS JOHNSTONI, Reichb. fil., sp. nov. Kilima-njaro, 5000–6000 ft.

DISPERIS KERSTENI, Reichb. fil. Kilima-njaro, 7500 ft.

HABENARIA, aff. *H. macranthæ*, Hochst. Kilima-njaro, 6000 ft.

HABENARIA STYLITES, Reichb. fil. & S. Moore. Kilima-njaro, 2000–3000 ft.

HABENARIA PLEISTADENIA, Reichb. fil. Kilima-njaro, 8000–10,000 ft.

HABENARIA RARICOLORATA, Reichb. fil., sp. nov. Kilima-njaro, 7000 ft.

SATYRIUM CHLOROCORYS, Reichb. fil., sp. nov. Kilima-njaro, 7000 ft.

DISA DECKENII, Reichb. fil. Kilima-njaro, 6000–8000 ft.

ACIDANTHERA LAXIFLORA, Baker, sp. nov.; cormo parvo globoso tunicis brunneis membranaceo-fibrosis, foliis basalibus productis 3 linearibus firmulis glabris, floribus 2–6 in spicam laxissimam erectam dispositis, spathæ valvis magnis lanceolatis viridibus, perianthio tubo longissimo cylindrico, limbi albi segmentis obovatis obtusis tubo quadruplo brevioribus, antheris limbo duplo brevioribus connectivo ultra loculos breviter producto.

Maungu, 2000 ft.

Cormus 6 lin. diam. Folia producta semipedalia vel pedalia, medio 3–4 lin. lata. Spathæ $1\frac{1}{2}$–$2\frac{3}{4}$ poll. longæ. Perianthii tubus 3–4-pollicaris, limbus 9–10 lin. longus, segmentis 4–$4\frac{1}{2}$ lin. latis. Antheræ semipollicares.

GLADIOLUS (§ EUGLADIOLUS) PAUCIFLORUS, Baker, n. sp.; foliis basalibus productis 3 elongatis linearibus firmulis glabris, caule 2–3-ped. simplici foliis 2 reductis supra medium prædito, spica laxissima erecta pauciflora, spathæ valvis lanceolatis magnis viridulis, perianthio albido suberecto, tubo anguste infundibulari spathis inferioribus paulo longiore, limbi segmentis oblongis subobtusis, genitalibus limbo conspicue brevioribus. Ad *G. angustum*, L., magis accedit.

Kilima-njaro, 2000–5000 ft.

Folia basalia producta pedalia, 3–4 lin. lata. Caulis 2–3-pedalis. Spica semipedalis. Spathæ 1–$1\frac{1}{2}$ poll. Perianthium 3 poll., segmentis tubo paulo brevioribus, medio 6 lin. latis.

GLADIOLUS (§ EUGLADIOLUS) SULPHUREUS, Baker, n. sp.; fibris radicalibus cylindricis, cormo globoso membranaceo-tunicato, foliis productis 5–6 ensiformibus brevibus coriaceis glabris erectis, caule valido simplici erecto, floribus suberectis 10–12 in spicam laxam dispositis, spathæ valvis magnis lanceolatis chartaceis brunneis, perianthii tubo anguste infundibulari spathis inferioribus æquilongo, limbo sulphureo suberecto tubo æquilongo, segmentis obovatis obtusis, supremo arcuato lateralibus latiore, infimo reliquis multo minore, genitalibus perianthio paulo brevioribus.

Ab *G. Quartiniano* recedit foliis brevibus, perianthio suberecto segmento supremo solum leviter arcuato.

Kilima-njaro, 5000 ft.

Cormus 8–9 lin. diam. Folia producta 4–5 poll. longa, medio 6 lin. lata. Caulis 8–9-pollicaris. Racemus 8–9-pollicaris. Spathæ 1–$1\frac{1}{2}$ poll. longæ. Perianthium 3 poll. longum, segmento supremo 8–9 lin. lato, lateralibus 6 lin. latis, infimo 8–9 lin. longo.

GLADIOLUS WATSONIOIDES, Baker. 8500–11,000 ft.

GLADIOLUS WATSONIOIDES, Baker, var. MINOR. Up to 13,000 ft.

GLADIOLUS QUARTINIANUS, A. Rich. 7000 ft.

ARISTEA ALATA, Baker. 7000 ft.

DIERAMA PENDULA, Baker. 8300–10,000 ft.

HÆMANTHUS ABYSSINICUS, Herb.,=*H. tenuiflorus,* Herb. 40–60 miles inland.

DIOSCOREA, aff. *D. crinitæ*, Hook. f. 6000 ft.

ASPARAGUS FALCATUS, L. Kilima-njaro, 5000 ft.

ASPARAGUS, verosimiliter sp. nov., flowers 0.
An aff. *A. plumoso* ? Kilima-njaro, 2000–3000 ft.

ASPARAGUS, aff. *A. plumoso*, Baker. (No flowers.) 8000 ft.

GLORIOSA VIRESCENS, Lindl. Kilima-njaro, 2000–3000 ft.

SCILLA (§ LEDEBOURIA) JOHNSTONI, Baker, sp. nov. ; bulbo magno globoso tunicis pluribus membranaceis, foliis binis synanthiis subsessilibus ovatis vel obovatis obtuse cuspidatis tenuibus glabris, scapis 4 foliis eminentibus, floribus perpluribus in racemum cylindricum dispositis, pedicellis flori æquilongis, bracteis minutis lanceolatis, perianthio oblongo medio constricto splendide rubro-purpureo, segmentis lanceolatis uninervatis basi oblongis flore expanso supra basin patulis, staminibus perianthio æquilongis, stylo breviter exserto stigmate capitato.

Ad *S. lilacinam* (*nubicam*), Baker, in Journ. Linn. Soc. xiii. 250, et *S. Hildebrandtii*, Baker, inedit. (Hildebrandt, 2644) accedit.

40–60 miles inland.

Bulbus $1\frac{1}{2}$ poll. diam. Folia 3–4 poll. longa, 2–$2\frac{1}{2}$ poll. lata. Scapus 6–8-pollicaris. Racemi semipedales, expansi 15–18 lin. diam. Perianthium 3–$3\frac{1}{2}$ lin. longum.

WALLERIA NUTANS, Kirk. Taveita.

BULBINE ASPHODELOIDES, Roem. & Sch. 40–60 miles inland.

ORNITHOGALUM (§ OSMYNE) MELLERI, Baker. 40–60 miles inland.

KNIPHOFIA THOMSONI, Baker. 8000–11,000 ft.

ALOE, perhaps near *A. commutata*, Tod. Material inadequate. 3000–6000 ft.

ALOE (§ EUALOE) JOHNSTONI, Baker, n. sp. (Plate LXIII.) Acaulis, rhizomate tuberoso globoso, foliis productis 8–12 erectis linearibus rigidulis ad marginem minute aculeatis sursum concoloribus deorsum conspicue albo maculatis basi in laminam chartaceam albidam deltoideam dilatatis, scapo simplici tereti erecto foliis subæquilongo bracteis paucis vacuis ovatis cuspidatis scariosis prædito, racemo denso brevi subcorymboso multifloro, pedicellis elongatis strictis ascendentibus, bracteis magnis scariosis oblongo-navicularibus cuspidatis, perianthio parvo cylindrico obscure rubello, tubo brevissimo, segmentis lanceolatis, exterioribus dorso laxe trinervatis, genitalibus perianthio æquilongis, fructu oblongo capsulari perianthio æquilongo.

Ad *A. Cooperi*, Baker, in Journ. Linn. Soc. xviii. 155 ; Bot. Mag. t. 6377, magis accedit.

Kilima-njaro, 2000–5000 ft.

Folia pedalia vel semipedalia, medio $1\frac{1}{2}$ lin. lata, basibus dilatatis scariosis 8–9 lin. latis. Racemus 2–3-pollicaris. Pedicelli inferiores 9–10 lin. longi. Perianthium 7–8 lin. longum.

DRACÆNA, sp. nov. Near *D. Smithii*, Baker. Material inadequate for description. 6000–9000 ft.

ANTHERICUM (§ PHALANGIUM) VENULOSUM, Baker, sp. nov.; fibris radicalibus cylindricis, collo radicis setis paucis deciduis cincto, foliis omnibus radicalibus lineari-lanceolatis rigidulis conspicue venulosis facie glabris margine incrassatis conspicue ciliatis, caule ancipiti simplici foliis breviore, racemo laxo elongato simplici erecto, pedicellis medio articulatis flore brevioribus solitariis vel geminis, bracteis membranaceis pallidis lanceolatis vel ovatis, perianthii albidi segmentis oblanceolato-oblongis medio crebre 3–5-nervatis, staminibus perianthio æquilongis, filamentis glabris antheris lanceolatis æquilongis, fructu globoso, capsulæ valvis lineis transversalibus rugosis, seminibus turgidis nigris in loculo pluribus superpositis.

Kilima-njaro, 2000–5000 ft.

Folia radicalia producta sæpe 6 semipedalia vel pedalia plana vel crispato-undulata, medio 5–6 lin. lata. Racemus 3–6-pollicaris. Bracteæ inferiores 3 lin. longæ; superiores sensim minores. Pedicelli 2 lin. longi. Perianthium 4 lin. longum.

ANTHERICUM (§ PHALANGIUM) RUBELLUM, Baker, sp. nov.; fibris radicalibus duris, collo radicis dense setoso, foliis omnibus radicalibus linearibus firmulis glabris crebre nervatis, caule ancipiti, racemis erectis laxis simplicibus vel basi furcatis, pedicellis solitariis vel geminis medio articulatis, bracteis parvis ovatis castaneis scariosis, perianthii rubelli segmentis lanceolatis patulis dorso 5–7 nervatis, antheris magnis linearibus filamentis brevibus glabris, fructu globoso capsulæ valvis lineis transversalibus glabris rugosis, seminibus turgidis nigris in loculo pluribus superpositis.

Ad *A. zanguebaricum*, Baker, in Journ. Linn. Soc. xv. 302, magis accedit.

Kilima-njaro, 5000 ft.

Folia producta 6–8 semipedalia medio 3 lin. lata ad basin et apicem sensim attenuata. Caulis subpedalis. Racemus primarius 2–3 poll. Pedicelli 3 lin. longi. Perianthium 4 lin. longum. Antheræ 2 lin. longæ.

DASYSTACHYS GRANTII, Benth. Kilima-njaro, 5000 ft.

DASYSTACHYS ? (inadequate). Kilima-njaro, 5000 ft.

COMMELYNA, near *C. latifolia*, Hochst. Kilima-njaro, 5000 ft.

ANEILEMA SINICUM, Lindl. Kilima-njaro, 5000 ft.

ANEILEMA ÆQUINOCTIALE, Kunth. Maungu, 5000–6000 ft.

ANEILEMA, cf. *A. lanceolatum*. Kilima-njaro, 2000–3000 ft.

ANEILEMA PEDUNCULOSUM ?, C. B. Clarke. Up to 9000 ft.

PHŒNIX, sp. Nearly to 6000 ft.

Spadices only "Mkindo" palm.

LUZULA FORSTERI, DC., forma? 8000–9000 ft.

CYPERUS DICHROSTACHYS, Hochst. Kilima-njaro, 6000 ft.

CYPERUS ROTUNDUS, L., forma (*C. adoensis* ?). Kilima-njaro, 4000–5000 ft.

CYPERUS PANICEUS, Boeckl. ? Kilima-njaro, 5000 ft.

CYPERUS LEPTOCLADUS, Kunth. (Apparently *C. ingratus* of the Cameroons and Fernando Po lists.) 6000 ft.

KYLLINGA CYLINDRICA, Nees ? 6000 ft.

FIMBRISTYLIS, an *F. hispidula* (*glabrata*) ? Kil. Exped. No detail.

FIMBRISTYLIS (*Abildgaardia pilosa*, Nees). 40–60 miles inland.

FIMBRISTYLIS (§ ONCOSTYLIS), apparently *Isolepis schœnoides*, Kunth, of Sir J. Hooker, in Report on Cameroons plants (Journ. Linn. Soc. vii. 225): *Schœnus* ? *erraticus* (*l. c.* vi. 22); *Scirpus* (§ *Oncostylis*) *atrosanguineus*, Boeckl., in Engler, Bot. Jahrb. vii. 276.

CAREX, an *C. Wahlenbergiana*, Boott ? With specimens from 6000–10,000 ft.

CAREX JOHNSTONI, Boeckl., in Engler, Bot. Jahrb. vii. 278. 6000–10,000 ft.

CAREX TRIQUETRIFOLIA, Boeckl., *l. c.* p. 279. 12,000 ft.

ISACHNE MAURITIANA ?, Kunth. 7000 ft.

PANICUM EXCURRENS, Trin. (*P. plicatum*, var. ?). 7000 ft.

PANICUM (TRICHOLÆNA), an *P. longisetæ*, Hochst., var. ? 4400 ft.

PANICUM (TRICHOLÆNA ?). Fragment. 6000 ft.

OPLISMENUS COMPOSITUS ?, Beauv. Fragment. 5300 ft.

ANDROPOGON (CYMBOPOGON) CYMBARIUS, L., forma. 6000 ft.

ANDROPOGON (CYMBOPOGON) HIRTUM, L., var. 6000 ft.

ANTHISTIRIA, an *A. abyssinica*, Hochst. ? 8300; 10,000–11,000.

ELIONURUS ARGENTEUS, Nees. Kilima-njaro, 5000 ft.

ARISTIDA ADOENSIS, Hochst. Kilima-njaro, 5000 ft.

SPOROBOLUS INDICUS, R. Br. (*S. elongatus*, R. Br.). Kilima-njaro, 5000 ft.

ANTHOXANTHUM ODORATUM, L., var. ? or a new species closely allied. 13,200 ft. The genus is new to Tropical Africa. There is but a single specimen, remarkably robust, with somewhat hirsute leaves $\frac{1}{4}$–$\frac{1}{3}$ in. broad, rapidly tapering to subacute apex, with strongly striate sheaths, and narrow, compact, purplish inflorescence.

KOEHLERIA CRISTATA, Pers., var. (*Airochloa convoluta*, Hochst.). A single leafless culm of nearly 2 feet. 7000 ft.

ERAGROSTIS SCHIMPERI, Benth. *Harpachne* (Hochst.). Kilima-njaro, 6000 ft.

ERAGROSTIS, sp. Two leafless culms. 6000 ft.

FESTUCA MACROPHYLLA, Hochst., var. ? 12,000–14,000 ft.

FESTUCA, aff. *F. Schimperianæ*, Rich., an imperfect leafless specimen. 13,000 ft.

HYMENOPHYLLUM POLYANTHOS, Sm. Trunks of trees. 18,000 ft.

CYSTOPTERIS FRAGILIS, Bernh. Crannies of rock at 13,000 ft.

ADIANTUM CAUDATUM, L. 4300 ft.

ADIANTUM ÆTHIOPICUM, L. 4000–6000 ft.

ADIANTUM CAPILLUS-VENERIS, L. 5000–6000 ft.

CHEILANTHES MULTIFIDA, Sw. 4000–7000 ft.

PELLÆA GERANIÆFOLIA, Fée. 4000–7000 ft.

PELLÆA HASTATA, Fée. 4000–7000 ft.

LONCHITIS PUBESCENS, Willd. 6000–8000 ft.

PTERIS FLABELLATA, Thunb. 4000–8000 ft.

PTERIS AQUILINA, L. Up to 10,000.

PTERIS QUADRIAURITA, Retz. 4000–7000 ft.

ASPLENIUM MONANTHEMUM, L. 10,000 ft.

ASPLENIUM FURCATUM, Thunb. 4000–8000 ft.

ASPLENIUM LUNULATUM, Sw. 4000–8000 ft.

ASPLENIUM CICUTARIUM, Sw. 7800 ft.

ASPLENIUM SANDERSONI, Hook. 8000 ft.

ASPLENIUM (§ DAREA) LOXOSCAPHOIDES, Baker, n. sp.; frondibus oblongo-lanceolatis subcoriaceis bipinnatifidis facie glabris dorso obscure purpuraceis, rhachide brunneo facie profunde canaliculato dorso rotundato obscure furfuraceo, pinnis multijugis lanceolatis sessilibus ad costam anguste alatam pinnatifidis, pinnulis lanceolatis uninerviis adnatis parallelis segregatis ascendentibus simplicibus vel paucis inferioribus apice furcatis, soris solitariis centralibus oblongis, involucro glabro firmulo margine integro.

Stipites et caudex desunt. Lamina 15–18 poll. longa, 5–6 poll. lata. Pinnæ inferiores 4–5 poll. longæ, 5–6 lin. latæ.

Ad *A. pteridoidem*, Novæ Caledoniæ, et *A. rutæfolium* Africanum magis accedit.

Kilima-njaro, 8000 ft.

ASPLENIUM (§ DAREA) SERTULARIOIDES, Baker, n. sp.; frondibus oblongo-lanceolatis bipinnatifidis subcoriaceis utrinque viridibus facie glabris dorso parce paleaceis, stipitibus brevibus cum rhachidibus nigro-brunneis paleis adpressis lanceolatis vestitis, pinnis multijugis lanceolatis sessilibus ad costam anguste alatam pinnatifidis basi inæqualibus antice productis postice cuneato-truncatis, multis inferioribus reductis, pinnulis erecto-patentibus contiguis adnatis, superioribus lanceolatis simplicibus integris, inferioribus multis apice emarginatis vel furcatis, infimo antico cuneato majore pinnatifido, soris solitariis parvis oblongis, involucro firmulo glabro margine integro.

Lamina 8–15-pollicaris, medio 2–3 poll. diam., stipite 2–3-pollicari. Pinnæ centrales 1½–2 poll. longæ, deorsum 3 lin. latæ.

Forma adest involucro subnullo.

Ad *A. Belangeri*, Kunze, magis accedit.

Kilima-njaro, in locis aquosis. 9000 ad 13,000 pedes, frequens.

ASPLENIUM THUNBERGII, Kunze. 5000 ft.

ASPIDIUM ACULEATUM, Sw. 4000–8000 ft.

ASPIDIUM. Bed of stream at 13,700 ft.

NEPHRODIUM MOLLE, Desv. 4000–10,000 ft.

NEPHRODIUM CICUTARIUM, var. GEMMIFERUM (Fée). 4000–8000 ft.

POLYPODIUM PHYMATODES, L. 5000 ft.

ACROSTICHUM HYBRIDUM, Bory. 8000 ft.

ACROSTICHUM AUBERTII, Desv. 8000 ft.

MOHRIA VESTITA, Baker, n. sp. Dense cæspitosa, stipibus brevibus rhachidibusque paleis linearibus membranaceis patulis pallide brunneis vel albidis dense vestitis, frondibus oblongis bipinnatis facie viridibus obscure glanduloso-paleaceis dorso dense paleaceis, pinnis oblongis sessilibus, infimis reductis latioribus, pinnulis oblongis adnatis obtusis contiguis conspicue inciso-crenatis, sporangiis pinnularum totam marginem occupantibus.

Stipites 9–12 lin. longi. Lamina 3–4-pollicaris, medio 15–18 lin. diam. Pinnæ centrales 8–9 lin. longæ, 3–4 lin. latæ.

Ab *M. caffrora* Capensi et Mascaranensi præsertim indumento recedit.

Kilima-njaro, ad rupium fissuras. 6000 ft.

LYCOPODIUM CLAVATUM, L. 7500–8500 ft.
SELAGINELLA RUPESTRIS, Spring. 40–60 miles inland.
SELAGINELLA MOLLICEPS, Spring. 5000 ft.
MARCHANTIA (no fruit).
GRIMMIA, sp. 12,000 ft.
DICRANUM, sp. 10,000 ft.
THUIDIUM, sp. 10,000 ft.
PHYSCIA FLAVICANS (Sw.).
PHYSCIA SPECIOSA (Wulf.).
PARMELIA PERLATA (L.).
PARMELIA, sp. 14,300 ft.
USNEA, sp.

DESCRIPTION OF THE PLATES.

PLATE LX.

Figs. 1–9. *Senecio Johnstoni,* Oliver, n. sp. 1, a reduced sketch of the trees, drawn from nature by Mr. Johnston; 2, the leaf, natural size; 3, cluster of the inflorescence, also natural size; 4, involucral bract; 5, ray-floret; 6, disk-floret; 7, seta of pappus; 8, stamens; 9, cleft style. Figs. 4 to 9 enlarged.

PLATE LXI.

Figs. 1–9. *Gazania diffusa,* Oliver, n. sp. 1, the plant, nat. size; 2, involucre laid open; 3, ray-floret; 4, disk-floret; 5, stamen; 6, style; 7, fruit; 8, scale of pappus; 9, hairs of ovary. Figs. 2–9 considerably enlarged.

PLATE LXII.

Figs. 1–2. *Ipomœa bullata,* Oliver, n. sp. 1, portion of plant in flower, nat. size; 2, stamen, seen laterally.

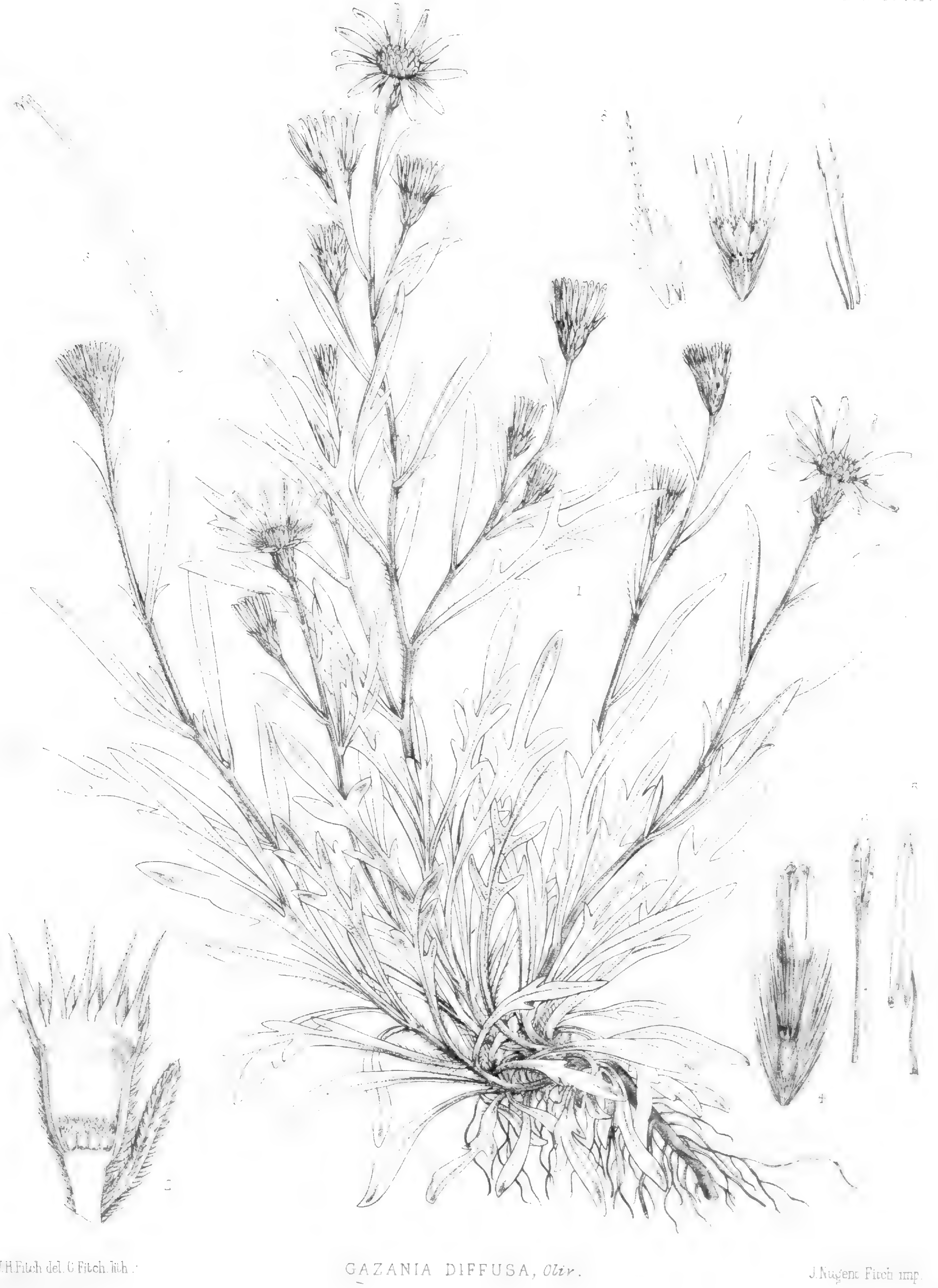
PLATE LXIII.

Figs. 1–8. *Aloe* (§ *Eualoe*) *Johnstoni,* Baker, n. sp. 1, the plant, nat. size; 2, portion of leaf showing spines; 3, flower, side view; 4, stamen; 5, pistil; 6, stigma; 7, fruit, nat. size; 8, the fruit, enlarged.

M. Smith del. J. N. Fitch lith.

SENECIO JOHNSTONI, Oliv.

J. Nugent Fitch imp.



W. H. Fitch del. G. Fitch lith.

GAZANIA DIFFUSA, *Oliv.*

J. Nugent Fitch imp.

W.H.Fitch del. C.Fitch lith.

IPOMÆA BULLATA, *Oliv.*

J.Nugent Fitch imp.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	Part II.	1882	0	5	0	0	3	9
	Part III.	1883	0	10	0	0	7	6
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	Part V.	1883	0	3	0	0	2	3
	Part VI.	1884	0	13	6	0	10	0
	Part VII.	1884	0	9	6	0	7	0
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	Part XI.	1886	0	6	0	0	4	6
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	Part XIV.	1887	0	7	0	0	5	0
	Part XV.	1887	0	10	0	0	7	6

2nd Ser. BOTANY.] [VOL. II. PART 16.

THE

TRANSACTIONS

OF

THE LINNEAN SOCIETY OF LONDON.

TITLEPAGE, CONTENTS, AND INDEX.

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INDEX.

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	Part XV.	1885	0	4	6	0	3	6
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	Part VI.	1888	0	6	0	0	4	6
IV.	Part I.	1886	1	4	0	0	18	0
	Part II.	1887	1	8	0	1	1	0
	Part III.	1888	0	16	0	0	12	0
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	Part V.	1878	1	4	0	0	18	0
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II.	Part I.	1881	0	12	0	0	9	0
	Part II.	1882	0	5	0	0	3	9
	Part III.	1883	0	10	0	0	7	6
	Part IV.	1883	0	3	0	0	2	3
	Part V.	1883	0	3	0	0	2	3
	Part VI.	1884	0	13	6	0	10	0
	Part VII.	1884	0	9	6	0	7	0
	Part VIII.	1884	0	10	0	0	7	6
	Part IX.	1886	0	7	0	0	5	0
	Part X.	1887	0	3	4	0	2	6
	Part XI.	1886	0	6	0	0	4	6
	Part XII.	1886	0	8	0	0	6	0
	Part XIII.	1887	1	7	0	1	0	0
	Part XIV.	1887	0	7	0	0	5	0
	Part XV.	1887	0	10	0	0	7	6
	Part XVI.	1888	0	2	6	0	2	0
III.	Part I.	1888	3	12	0	2	14	0