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DESCRIPTION OF THE PLATES.

PLATE VII.

- Fig. 1. *Kilchingia gracilipes*, Baker.
 2. Section of the corolla, to show stamens and their insertion, nat. size.
 3. The carpels, also of natural size.

PLATE VIII.

- Fig. 1. *Rhodocodon madagascariensis*, Baker.
 2. A section of the perianth, to show nerving and proportion of segments to tube, enlarged.
 3. A section of the perianth, to show the stamens and their insertion, also enlarged.
 4. The pistil, magnified.
 5. The lower bract, also enlarged.

Notes on Orchidæ. By GEORGE BENTHAM, F.R.S.

[Read January 20, 1881.]

THE wonderful variety in the forms of tropical Orchidæ, and the singular complications of their fertilizing-apparatus, early caught the attention of several of the most eminent botanists; and in the latter portion of last century and the first decades of the present one we had already special treatises on them from Swartz, the two Richards (father and son), Dupetit-Thouars, Robert Brown, Blume, and others. The sagacious observations of Brown, backed by the splendid drawings of Bauer, induced Lindley to devote himself to the study of the Order, of which he became the great master. At the same time one of the results of the labours of the Horticultural Society was the general spread of a taste for the cultivation of tropical plants amongst the wealthy, and amongst these Orchidæ soon took a prominent place. Already, in the celebrated stoves of Loddiges of Hackney, a considerable number were successfully grown, and they began to appear in the then newly established Horticultural exhibitions. It was at one of these that the Duke of Devonshire, President of the Horticultural Society, was so struck with the singularity of the *Oncidium Papilio*, that he determined to form a special collection of the Order in the stoves at Chatsworth. This set

the fashion amongst the wealthy amateurs; and the amount of money now spent in the collection, importation, cultivation, and illustration of the innumerable showy forms would, if summed up, appear quite fabulous. At the same time, in a scientific point of view, the interest in the Order has been as much intensified by the investigations of Darwin, showing how important in the life-history of the several races are those singular modifications in the fertilizing-apparatus and its protecting perianth, which had till then only excited curiosity.

For the systematic arrangement of the several races of Orchidæ the preliminary labours of Swartz, published in the Transactions of the Academy of Stockholm for 1800, were excellent for the time, but became obsolete from the great influx of new forms unknown to him. Robert Brown, in the fifth volume of the second edition of Aiton's 'Hortus Kewensis,' and in his Prodrômus of the Australian Flora, first established the principles of their classification on a solid basis; and this was thoroughly worked out by Lindley, in as far as his materials allowed, in a variety of works, and the results summarized in his 'Genera and Species of Orchids,' many of the genera further revised, with the fresh materials received up to the years 1853 to 1855, in his 'Folia Orchidacea.' Since that time, notwithstanding the many eminent botanists who have worked at the Order, we have had no systematic digest of the genera and species so largely multiplied during the twenty-five or thirty years that have elapsed; and the greater number of the splendidly illustrated works on Orchidæ which have been published have been chiefly devoted to showy species, and almost always unaccompanied by any analysis exhibiting their generic characters. There are, however, some important exceptions; and in the first rank must be placed Blume's works. They all show, in whatever tribe of plants he took in hand, a wonderful acuteness and correctness of observation. His first great work, the 'Bijdragen tot de Flora van Nederlandsch Indië,' worked out and printed in Java without the aid of European herbaria and libraries, is exceptionally free from mistakes and blunders; and though many of his sections may have become genera, or some of his genera reduced to sections, yet they have almost all been adopted as distinct groups. In Orchidæ the portion of the fourth volume of his 'Rumphia,' and the splendid volume devoted to the Order, are as yet unsurpassed models of true botanical illustration.

Besides these, the best analyses of the generic characters are given in Sir William Hooker's 'Exotic Flora,' in some of the plates of the 'Botanical Magazine,' in the Illustrations of Wight and of Griffith, in the younger Hooker's Floras, in Fitzgerald's 'Australian Orchids,' and in a few of Lindley's illustrated works. I would also call attention to the excellent detailed exposition of the structure of the flower given in the fourth volume of the Memoirs of the Paris Museum (1818), under the title of "De Orchideis Europæis Adnotationes," by the elder Richard, who in this, as in all his other works, was much in advance of his time.

I now come to speak of the great Orchidologist of the present day, who took up the pen and pencil as they fell from the hands of Lindley, and who, having since devoted himself almost exclusively to the study of the Order, is now the only authority for the determination of species, especially for those in cultivation. I allude to the younger Reichenbach. No one has a richer collection of specimens than his, no one has more opportunities of examining the flowers in a living state, no one is more thoroughly acquainted with their peculiarities, or has better means of giving us a new Genera and Species of Orchidaceæ; but unfortunately no such a one has as yet appeared, and I cannot learn that any one is in preparation. In his numerous publications he has proposed, modified, combined, or suppressed a large number of genera; but he has nowhere as yet given any synopsis of contrasted characters so as to give a clue to the principles upon which he would limit the tribes and genera he would adopt; so that whilst cordially agreeing in many of the changes he proposes, there are others for which I have failed to comprehend his reasons. He appears, for instance, generally to rely absolutely on floral characters, to the exclusion of vegetative ones, more on the absolute number than on the form and arrangement of the pollen-masses, and often to attach much more importance to the calli, lobes, and appendages of the labellum and column than I should do in respect of genera. I trust, however, he may yet give us a clue to his systematic views in time for use in the new part of our 'Genera Plantarum' now in preparation.

Dr. Pfister, of Heidelberg, has, on the other hand, taken up the study of Orchidæ according to their vegetative characters, the importance of which I did not fail to recognize as soon as I

began to consider the general arrangement of the Order. I am not aware that he has as yet published the results of his investigations; but on the occasion of his visit to Kew last spring he called my attention to various points which I had overlooked.

The general principles upon which Lindley divided the Order remain true to the present day, although his tribes may require some modification in detail, the distinctive characters having become better understood, and proving not near so constant as they appear at first sight, and their definitions, as generally received, often very vague, owing chiefly to the inaccuracy of some of the terms used. Some botanists have therefore recently proposed to overturn the system altogether; but I am not aware of any plausible one being substituted for it. J. G. Beer, of Vienna, in his 'Praktische Studien an der Familie der Orchideen,' 1854, a work chiefly horticultural, after strongly criticising Lindley's classification, proposes a division of the Order into six tribes founded solely on modifications of the labellum, to the total neglect of all other characters, structural or vegetative. He goes no further in his systematic arrangement, but gives under each tribe an alphabetical list of genera; where we find, for instance, *Orchis* and *Habenaria* in the second tribe associated with *Angræcum*, *Phaius*, *Calanthe*, *Corallorhiza*, and others, whilst *Scrapias* and *Ophrys* are in the fifth tribe associated with *Oncidium*, *Luisia*, *Malaxis*, *Epipactis*, *Caladenia*, and others, resulting in the most incongruous medley conceivable. Nine years later, in his 'Beiträge zur Morphologie und Biologie der Orchideen,' a larger work, valuable for the accurate delineation and description of the capsules and seeds of all the species which he could obtain in fruit, and of the germination of several of them, he still insists on the value of his tribes, reducing them only from six to five, by the exclusion of *Cypripedium* from the order.

The Lindleyan system has been shortly summarized as follows:—

• *Pollen-masses waxy.*

Malaxideæ. No caudicle.

Epidendreeæ. One or two caudicles, but no gland.

Vandeeæ. One or two caudicles attached to a gland.

•• *Pollen-masses granular or powdery.*

Ophrydeæ. Anther adnate to the top of the column.

Arethuseæ. Anther operculate, over the rostellum.

Neottiacæ. Anther erect, behind the rostellum.

*** *Abnormal tribes.*

Cypripediæ. Anthers 2.

Apostasiæ. Anthers 2 or 3; ovary 3-celled.

The primary division, founded on the consistence of the pollen, has not been replaced by any other equally good; although it is by no means absolute. The waxy pollen-masses of some species of *Phaius* and *Bletia*, for instance, appear to be tardily formed, the granular mass of pollen sometimes filling the whole anther-cells; the powdery pollen of *Eriochilus*, *Acianthus*, and some others is almost consolidated into waxy masses; and the waxy masses of *Earina* and others will at length resolve themselves into powdery granules; but these exceptions are very rare, and almost isolated among the immense number of genera where the distinction is constant.

The distinctions, however, founded upon the so-called caudicles and gland can scarcely be maintained, independently of the confusion occasioned by the term *caudicle* having been applied to three very different parts of the pollinary system:—1. The true caudicle is the extension of the smaller end of a pollen-mass into a tail-like point, corresponding to the caudicle of the pollen-mass in *Asclepiadææ*. It is specially exemplified in most *Ophrydææ*, and to a certain degree in a few other genera, such as *Liparis*, *Eria*, *Calanthe*, &c. It is a part of the pollen-mass, though often of a rather different consistence, and is included with it in the as yet unopened anther-cell. 2. The so-called caudicle of *Epidendrum* and its allies is, in like manner, included in the anther-cell before it opens, but does not form part of each distinct pollen-mass. It is a variously shaped mass of loosely connected pollen-grains, as variously attached to the two or four pollen-masses of each cell, to which it forms a sort of appendage, and might therefore, in technical descriptions, be distinguished from the caudicle by the term *appendicula*, which seems more appropriate than that of *caudicula spuria* given it by Blume. It may be sometimes so much reduced as to make its presence or absence very difficult to ascertain from dried specimens, and to have caused several genera to be alternately placed in *Malaxidææ* and in *Epidendrææ*; in other, often closely allied, genera it may

exceed in bulk the pollen-masses themselves. 3. The so-called caudicle in *Vandææ* is very different both in origin and substance; it forms no part of the pollen, nor even of the anther, but is a production of the upper surface or back of the rostellum, being a prolongation of the so-called gland or detachable disk of the rostellum. Darwin, distinguishing it from the caudicle, proposes to call it a *pedicel*, which would have been an appropriate term but for its universal use in descriptive botany for the special designation of the pedicel of a flower. The term *stipes* is equally appropriate, and has not the same inconvenience, for it is generally used as the support of any organ. The presence of this stipes, though general in *Vandææ*, is by no means universal, and traces of it may be found in genera belonging to other tribes. The tribe of *Vandææ* can, however, be maintained with advantage with very nearly the limits assigned to it by Lindley, but founded on other characters; but the *Malaxidææ* and *Epidendrææ* must be amalgamated, as already suggested by Lindley, and may be divided into several tolerably distinct subtribes.

Of the three tribes with granular or powdery pollen, that of *Ophrydææ* remains as a very natural and perfectly distinct group as limited by Lindley, but requiring some little modification of the technical character; but the separation of *Arethuseæ* from *Neotticææ* has proved to be purely artificial, without even the advantage of a constantly definite distinctive character, although here again, as in *Epidendrææ*, several natural and tolerably well-characterized subtribes may be recognized.

In the small anomalous tribes *Cypripediææ* and *Apostasiææ* there is no alteration to propose other than their consolidation into a single one.

The result of a detailed examination of all the genera proposed or established of which I could procure specimens, living or dry, checked by published descriptions and illustrations, has been their distribution into five tribes, slightly modified from those of Lindley, and twenty-seven subtribes, of which I now give a short summary of the most essential characters, passing over for the present the exceptional forms. These exceptions will, I think, be found to be very few as connecting the tribes; but the subtribes are not always so definite, and it may be hoped that a further study of numerous forms of which we have at present only very imperfect materials may lead, in many respects, to considerable improvements in their circumscription.

I shall follow up this summary or conspectus with a few observations on the most important tribal and subtribal characters, and on the exceptions to them which have come under my notice, and on the genera I would include under each.

CONSPECTUS TRIBUUM (exceptis neglectis).

Tribus 1. *EPIDENDRÆ*. Anthera 1, postica, opercularis, sæpius incumbens, loculis distinctis parallelis. Pollinia cerea, 1-2-seriata, parallela, in quaque serie 2 v. 4 (in quoque loculo 1-4), libera v. visco parco v. appendicula granulosa in quoque loculo connexa, rariissime v. casu tantum rostello affixa.

Subtribus 1. *Pleurothallæ*. Caulis bulbosus, folio unico et inflorescentia terminatus.

Subtribus 2. *Microstylæ*. Anthera erecta v. prona, sæpe persistens nec incumbens.

Subtribus 3. *Liparidæ*. Inflorescentia terminalis. Pollinia 4, rarius 8, subæqualia, conferta, sæpius libera, inappendiculata.

Subtribus 4. *Dendrobicæ*. Inflorescentia lateralis v. pseudoterminalis v. in scapo distincto aphylo. Pollinia 4, rarius 2, 1-seriata, parallela, inappendiculata.

Subtribus 5. *Eriæ*. Inflorescentia lateralis v. pseudoterminalis v. in scapo distincto aphylo. Pollinia 8, subæqualia, conferta, vix v. non inappendiculata.

Subtribus 6. *Bleticæ*. Inflorescentia lateralis v. rarius terminalis. Pollinia 2-seriata (rarius 1-seriata), in quaque serie 4, parallela, omnia ascendentia, appendicula granulosa connexa.

Subtribus 7. *Calogyneæ*. Inflorescentia terminalis. Pollinia 8 v. 4, subæqualia, conferta, visco v. appendicula parca connexa.

Subtribus 8. *Stenoglossæ*. Inflorescentia terminalis. Pollinia 4, 6, v. 8, in locellis distinctis 1-2-seriata, libera v. visco tenui connexa.

Subtribus 9. *Lalicæ*. Inflorescentia sæpissime terminalis. Pollinia 1-2-seriata, in quaque serie 4, collateralia, parallela, compressa, appendicula granulosa connexa, inferiora ascendentia, superiora dum adsint descendentia.

Tribus 2. *VANDÆ*. Anthera 1, postica, opercularis, rostello incumbens v. applicita, loculis sub anthesi sæpissime confluentibus. Pollinia cerea, sæpissime 2 oblique v. transverse sulcata, v. 4 per paria sibimet applicita linea transversa separata, anthera dehiscente (sæpius jam in alabastro) rostelli processu (*glandula* v. *stipiti*) sigillatim v. per paria affixa, quorum pollinarium deciduum formant.

Subtribus 1. *Eulophicæ*. Folia pseudobulborum plicato-venosa. Scapi florentes aphylli v. foliati. Labellum calcaratum.

Subtribus 2. *Cymbidicæ*. Folia pseudobulborum plicato-venosa. Scapi florentes aphylli v. foliati. Labellum ecalcaratum. Columna sæpissime apoda.

Subtribus 3. *Cyrtopodieæ*. Folia pseudobulborum plicato-venosa. Scapi florentes aphylli. Columna sæpiissime in pedem producta.

Subtribus 4. *Stanhopieæ*. Folia pseudobulborum plicato-venosa. Scapi florentes aphylli. Columna sæpius apoda. Labelium carnosum.

Subtribus 5. *Maxillarieæ*. Folia non plicata. Scapi florentes aphylli v. pedunculi axillares. Columna in pedem producta.

Subtribus 6. *Oncidieæ*. Folia non plicata. Scapi florentes aphylli v. pedunculi axillares. Columna apoda.

Subtribus 7. *Sarcantheeæ*. Caules ebulbosi, distichophylli, rarius aphylli, radicanter. Folia non plicata. Pedunculi laterales v. axillares.

Subtribus 8. *Nothlieæ*. Rostellum terminale, erectum v. antrorsum inclinatum, postice sæpius concavum antheram fovens. Pollinarii stipes simplex v. duplex, angustus v. apice dilatatus, ab apice rostellii pendulus.

Tribus 3. *NEOTTIEÆ*. Anthera 1, postica, opercularis v. erecta persistensque, loculis distinctis parallelis. Pollinia granulosa pulverea v. sectilia. Caules ebulbosi.

Subtribus 1. *Vanilleæ*. Caules elati, sæpe ramosi, erecti v. alte scandentes. Racemi v. paniculæ terminales v. simul axillares. Anthera subopercularis, rostello brevi incumbens.

Subtribus 2. *Corymbieæ*. Caules elati interdum ramosi, foliis amplis. Racemi v. paniculæ terminales. Anthera erecta, rostello erecto parallela.

Subtribus 3. *Spirantheæ*. Caules simplices, erecti, foliis membranaceis rarius 0, rhizomate non tuberifero. Anthera erecta v. antrorsum inclinata, rostello longiusculo parallela.

Subtribus 4. *Disrideæ*. Caules simplices, erecti, aphylli 1-foliati v. rarius paucifoliati, rhizomate varie tuberifero. Anthera erecta v. antrorsum inclinata, rostello brevi v. rarius longiusculo.

Subtribus 5. *Arethuseæ*. Caules simplices, erecti, aphylli 1-foliati v. rarissime paucifoliati, rhizomate sæpius varie tuberifero. Anthera opercularis, incumbens v. suberecta.

Subtribus 6. *Limodoreæ*. Caules simplices, erecti, foliati v. rarius aphylli, rhizomate non tuberifero. Anthera opercularis, incumbens v. suberecta.

Tribus 4. *OPHRYDEÆ*. Anthera 1, postica, erecta prona v. reflexa, loculis parallelis v. divergentibus distinctis clinandrio adnatis basi que sæpe in rostello continuis. Pollinia granulosa, in quoque loculo basi in caudiculam producta, caudiculis anthera dehiscente extremitate glandulæ a rostello solvendæ affixis.

Subtribus 1. *Serapiadeæ*. Anthera erecta. Polliniorum glandula in sacculo a dorso rostellii elevato inclusa.

Subtribus 2. *Habenarieæ*. Anthera erecta. Polliniorum glandulæ nudæ v. rarius rostellii lobis canaliculatis v. apice inflexis semiinclusa.

Subtribus 3. *Diseæ*. Anthera reclinata v. in dorso columnæ reflexa rarius suberecta. Stigma amplum pseudoterninale v. labello subadnatum.

Subtribus 4. *Corycieæ*. Sepalum posticum cum petalis sæpius in galeam

coherens. Labellum basi columnæ adnatum, ultra antheram varie productum v. appendiculatum.

Tribus 5. CYPRIPEDIÆ. Antheræ 2, ad latera rostellii v. styli sessiles v. stipitatae, polline granuloso; anthera postica in antheridium polymorphum mutata, rarius perfecta v. omnino deficiens.

I now proceed to enter into a few explanatory details, taking the several tribes in the above order.

Tribe I. EPIDENDRÆ.

This tribe is formed of the union of Lindley's Malaxidæ and Epidendræ, which, as already observed, he had distinguished by the absence or presence of a caudicle to the pollen-masses; but owing to the vagueness of the meaning attached to the term caudicle, and the real uncertainty in many cases as to the substance which often connects the pollen-masses, there are so many genera whose place in the one or the other tribe has been a matter of doubt, that Lindley himself had suggested the consolidation of the two, and their subdivision on other principles. This process he unfortunately never carried out in detail, although he gave some indication of it in his lists of genera in his 'Vegetable Kingdom.'

As a whole, Epidendræ are chiefly distinguished from Vandæ, the other great tribe of Orchidæ with waxy pollen-masses, by the distinctness of the two anther-cells, which are always parallel, or nearly so, and after discharging their pollen leave their margins or valves prominent within the anther-case, and by the removal of the pollen without carrying off any scale-gland or stipes formed by a layer or plate detached from the rostellum. This character is, in the great majority of genera, well marked and readily ascertained; but in some instances it requires very careful observation not to mistake it, and sometimes may really be rather uncertain. In coming to the following conclusions, I have been guided in the first instance by Darwin's clear exposition of the results of his careful study of the process of fertilization in a few leading genera; and I have followed them up by the observation of such species as I have been able to procure in a living state, and by the close examination of buds and open flowers in dried specimens of a great majority of the genera, and generally of many species of the larger genera. I am fully aware, however, that in this respect dried specimens often give but very unsatisfactory data. In those gathered wild the pollen is often already carried off by insects from flowers but just expanded; and it is so readily dis-

zodium, Lindl., contains about ten species, well distinguished from *Disa* by the habit and by the position of the stigma. *Penthea*, Lindl., seven or eight species, united by Harvey with *Disa*, appears to differ constantly from that genus in the want of any spur to the dorsal sepal. *Brownleea*, Harv., has also the dorsal sepal without any spur, but a very concave or broadly saccate labellum and a stigma somewhat different from that of *Disa*. *Forficaria*, Lindl., is only known from a single specimen of Drège's in Lindley's herbarium, which, as far as I can tell without spoiling the specimen, does not seem quite to agree with the analysis sketched by Lindley. *Brachycorythis*, Lindl., four or five species, is readily known by its habit, and differs from *Schizodium* by the want of the spur to the dorsal sepal. *Schizochilus*, Sond., four species, has been united by Reichenbach with *Brachycorythis*; but the habit is very different, and the spur of the labellum is independent of the concave unguis of *Brachycorythis*, which also exists more or less in *Schizochilus* above the spur. *Platycoryne*, Reichb. f., is a single Madagascar species, differing from *Penthea*, as *Schizochilus* does from *Brachycorythis*, in the spurred labellum.

Subtribe 4. CORYCIEÆ.—In this subtribe the anther is usually more or less reflexed from the column, as in *Disæ*; but the labellum, adnate the whole length of the column, is produced between the anther-cells and beyond them into a variously formed appendage. The stigma, usually pressed between the labellum and the rostellum, becomes transverse or two-lobed. There are four undisputed genera:—*Pterygodium*, Swartz, including *Ommatodium*, Lindl., about ten species; *Disperis*, Swartz (*Dryopeia*, Thou.), about twenty species; *Corycium*, Swartz, about ten species; and *Ceratandra*, Endl., seven or eight species. All four are South African, one only, *Disperis*, also represented by a few species in tropical Africa, Madagascar, and East India.

Tribe 5. CYPRIPEDIÆ.

The four genera constituting this tribe differ so strikingly from the rest of the order in their andrœcium, that they have been proposed as forming one or two distinct natural orders. Now, however, that they are better known, they are found to be too closely connected together not to be united in a single tribe; and the importance of the single character which separates them from *Orchidæ* generally has fallen so much in estimated value, that they have by common consent been reunited with that order

as a distinct tribe only. Their habit is that of several Orchidæ (*Apostasia* often closely resembles *Corymbis*); they are all terrestrial, with erect simple leafy stems arising from a short or creeping rhizome, without tubers or pseudobulbs, their inflorescence terminal, simple, or slightly branched. Their perianth is various, but always within the limits of true Orchidæ. The column is short, bearing two perfect anthers, one on each side of the rostellum or style; the dorsal anther, the only one in other Orchidæ, is here usually reduced to a variously shaped barren staminodium; it is, however, perfect, as well as the lateral ones, in one genus, and totally deficient in one species of another genus. The rostellum or style is more or less prominent or elongated between the lateral anthers, and dilated at the end into a more or less oblique stigma. Their geographical distribution is northern or tropical; they are unknown in Africa, extratropical South America, or extratropical Australia.

The typical genus is *Cypripedium*, Linn., so well known for its slipper-shaped labellum, and agreeing with the other tribes of Orchidæ in its one-celled ovary and capsule with parietal placentas. Its cultivation for the beauty of its flowers has of late been so much the fashion, that horticulturists, by diligent research in its native localities and by careful hybridizing, have succeeded in carrying the number of its published species to above forty, several, however, to be hereafter reduced as varieties. In their wild state they are dispersed over Europe, temperate and tropical Asia, and North America, including Mexico. Their structure is far too uniform to admit of their being divided into sections, and can only be distributed into three series from minor differences in their foliage and the number of flowers, which, when more than one, are in a simple raceme, and very rarely above two or three in the raceme.

Selenipedium, Reichb. f., about ten species, replaces *Cypripedium* in the mountains of tropical America. The species have generally the slipper-shaped labellum of *Cypripedium*, under which genus most of them were first published; but a slight difference in habit and inflorescence (the flowers several in a simple or branched raceme), and the important character of the perfectly three-celled ovary and axile placentation, justifies their being maintained as a distinct genus, connecting *Cypripedium* with *Apostasia*. Two small-flowered species, *S. palmifolium*, Reichb. f., and another, have quite the habit of *Apostasia*. One species with