On the Structure of *Bonatea speciosa*, Linn. sp., with reference to its Fertilization.

By Roland Trimen, Memb. Ent. Soc. Lond. Communicated by Charles Darwin, Esq., F.R.S. & L.S.

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[Plate I.]

Mr. Darwin's remarks upon this curious and beautiful Orchid*, no less than his direct request that I should examine its structure, led me to search with care the neighbourhood of Cape Town in the hope of discovering it; but I met with no success. It was therefore with no ordinary pleasure that I received, through the kindness of Mr. Charles A. Fairbridge, one of the Trustees of the South African Museum, living flowers of *Bonatea speciosa*, which had expanded in a conservatory in Cape Town. The following details have been gathered from a careful examination of these flowers; and I trust that the accompanying figures will render them sufficiently intelligible.

The peculiar characters presented by the genus *Bonatea*, Willd., are given by Lindley and other authorities. It is sufficient to

* On the various Contrivances by which British and Foreign Orchids are Fertilized by Insects, &c., pp. 87, 302, 304, 330, 334.

observe that botanists agree in grouping it with *Habenaria*, Lindley remarking ('Gen. et Sp. Orchid.'), "*Bonatea* est *Habenaria* stigmate evolutissimo." My object here is limited to the illustration of the manner in which the structure of *B. speciosa* ensures the removal of the pollinia by insects resorting to the flower, and how fertilization ensues through the same agency.

The general aspect of the complete flower may be seen in figs. A. & B, of which the one gives a side, and the other a front view. The sepals, which are pale green, present nothing remarkable in form; but the two lower ones are sharply pointed and subfalcate, with their edges curled inwards underneath. The petals, on the contrary, are singularly shaped and greatly elongated. Each upper petal is divided almost to the base, with the green posterior portion standing erect, just within the margin of the upper sepal, and meeting at its apex the same portion of its fellow petal; while the white anterior portion projects almost at a right angle with the posterior, cohering, for a short distance, by its inner edge with the lower petal or labellum, and thence, widely diverging, becomes gradually broader, but somewhat abruptly narrows at the apex, which is prolonged and strongly recurved. The bright green labellum has a filiform dependent nectary as long as the ovarium, and is tripartite, its central lobe being much angulated, and depending between the lateral limbs, which project outward, more after the manner of the anterior portions of the upper petals.

The very remarkable cohesion of so many organs with the labellum has been correctly indicated by Mr. Darwin (*op. cit.* p. 304, note); and a reference to Fig. D will further illustrate this point. The long stigmatic processes (of which more hereafter) cohere on either side, for rather more than half their length, with the *upper* surface of the labellum; with its *outer* edges cohere, as has already been mentioned, the anterior portions of the upper petals for barely one-fourth of their length; and, finally, the inner edges of the lower sepals cohere with its *under* surface for about one-third of their length. It is thus clear that, as Mr. Darwin has pointed out, a section through the base of the labellum would divide these coherent parts also, passing in all through no less than *seven* (or, regarding the lateral limbs of the labellum as petaloid anthers of the outer whorl, *nine*) distinct organs.

The rostellum forms a very conspicuous green hood or helmet, constricted in its neck, and with the sides produced anteriorly into two long arms or horns projecting in an upward direction

and subconvergent. Its apex is similarly produced, but the process is shorter, and so recurved as to leave the front of the hood widely open*. The membrane at the anterior edge of the lateral horns is folded back throughout, forming grooves in which the caudicles of the pollinia (enveloped to their extremity in a continuation of the thin divided investing membrane of the pollen-masses) lie. The two disks are situated upon the apices of these horns, not far apart, with their viscid surfaces facing rather backward and towards the sides of the helmet. On each side of the base of the helmet, a little below the external edge of the groove containing the caudicle, is a small, thin, rounded winglet, which is an expansion of the membrane of the rostellum. These winglets evidently serve as guards against the escape of the very long and elastic caudicles from the grooves, which just there are widest and extremely shallow. It is very noticeable, that, immediately behind the winglets, the investing membrane of the caudicles (which lies free in the grooves) is firmly coherent with the column. The two widely-separated stigmatic surfaces are seated at the apices of a pair of wonderfully elongated white processes, having a common origin back in the neck, and at the base of the helmet, immediately behind the orifice of the nectary. These processes, cylindrical and apparently solid, are in reality tubular—the edges of each flattened expansion curling upward, and meeting very closely for about two-thirds of their length. Beyond this, the line of contact is marked, and the edges soon after diverge widely at the somewhat spoon-shaped and slightly concave surface of the stigma. The upper surface of the processes (forming the lining of the tubes) is very smooth and glossy, but not at all viscid.

It is not difficult to trace the perfect adaptation of the structure described to the removal of the pollinia and the subsequent fertilization of one or more flowers. An insect approaching the flower finds the opening of the nectary surrounded and guarded by the helmet-like rostellum. It seems probable that, as Mr. Darwin has shown in the case of *Angræcum sesquipedale*, the length of the nectary and the amount of nectar it contains are so contrived as to necessitate the hungry visitant's pushing even its head into the rostellum-cup in order to obtain the sweet fluid; and in such a case the attachment of one or both of the viscid

* The outer surface of the helmet (except the anterior portion of the lateral horns), as well as the *upper* surface of the recurved horn, is very minutely "shagreened" or roughened with points.

disks to some portion of the underside of the head or proboscis seems inevitable. It is right to mention that I found no nectar in either of the three nectaries that I opened; but it is possible that this was owing to cultivation in a greenhouse.

But supposing, on the other hand, that the nectary is well-filled with nectar, it would seem just possible, from the pollinia-disks being so far in front and the rostellum-helmet so widely open above, that a moth or fly with a long and flexible proboscis might obtain nectar without removing either pollinium. Few persons, indeed, who have watched the impetuous eagerness with which *Sphingidæ* and the larger *Noctuæ* rifle the honey of flowers, would consider it likely that the rapidly probing proboscis could avoid both disks—especially in the case of a *Noctua* (and of most Dipterous flies), which would certainly alight on the convenient landing-place afforded by the many cohering organs, and have to stretch its proboscis, if not its head, over the projecting arms of the rostellum. Yet such a chance does exist, and nature has provided against it. Immediately in front of the orifice of the nectary, back in the throat of the helmet, a stout, erect, white process or peg, rather more than a line in length and very slightly curved forwards at its apex, springs from the central portion of the labellum, and effectually bars any direct access to the nectary, only leaving a very small space on either side of it, through which the proboscis can be inserted (see fig. E). An insect is therefore compelled to make its approach to the nectary a little to one side or the other, and thus the attachment of one of the backward and laterally facing disks is absolutely ensured.

A pollinium once withdrawn, the mere weight of the pollen-mass causes it to hang downward, but the strong natural curve *in situ* of the very long caudicle is not thus overcome to any great extent, but is so far retained as to project the pollen-mass considerably beyond the line of a downward perpendicular from the disk (see fig. F). The position thus naturally assumed is admirably calculated to effect the attachment of pollen-grains to the viscid surface of the strangely produced and slightly dependent stigmas, which no pollinium with a shorter caudicle would be likely to reach. Nothing could be more interesting than the certainty with which the pollen-masses, when attached to a slender pin which had been and was anew pushed into the nectarial orifice, invariably struck the stigmas of the many flowers that I fertilized on the growing plant in Mr. Dickson's conservatory.

The most remarkable point in the structure of this Orchid is

undoubtedly the erect process of the labellum. Its sole use and object are so unmistakeable, and its abrupt prominence seems so foreign to the general character of the labellum and petals, that it would be difficult to find, even in the Orchidean order, a more striking instance of special modification. With the exception of this local development of the labellum, no part of the perianth appears directly to conduce to the fertilization of the flower; but the extraordinary modification of the columnar organs effects what is required. The lateral petals, which in so many South African *Ophreæ* are of the utmost importance, are of no direct service in *B. speciosa*, nor do I perceive the object of their marked posterior development, unless it be the strengthening of the protection afforded to the pollinia by the upper sepal. The prominent and magnificent group of cohering sepals and petals appears to serve the purposes of protecting and supporting the stigmatic processes and of affording a convenient landing-place for insects. Possibly too, its singular form may give it some attractive influence.

I am unable to supply any details as to the extent to which insect fertilization is effected in this Orchid, having had no opportunity of observing the plant in its native localities. But presuming the supply of nectar to be good, nothing seems wanting to ensure very frequent fertilization. The plant to which I have had access was brought from Kuysna, on the southern coast of the colony.

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Colonial Office, Cape Town,
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EXPLANATION OF THE PLATE.

A. Side view of complete flower.

B. Front view of complete flower, rather from above.

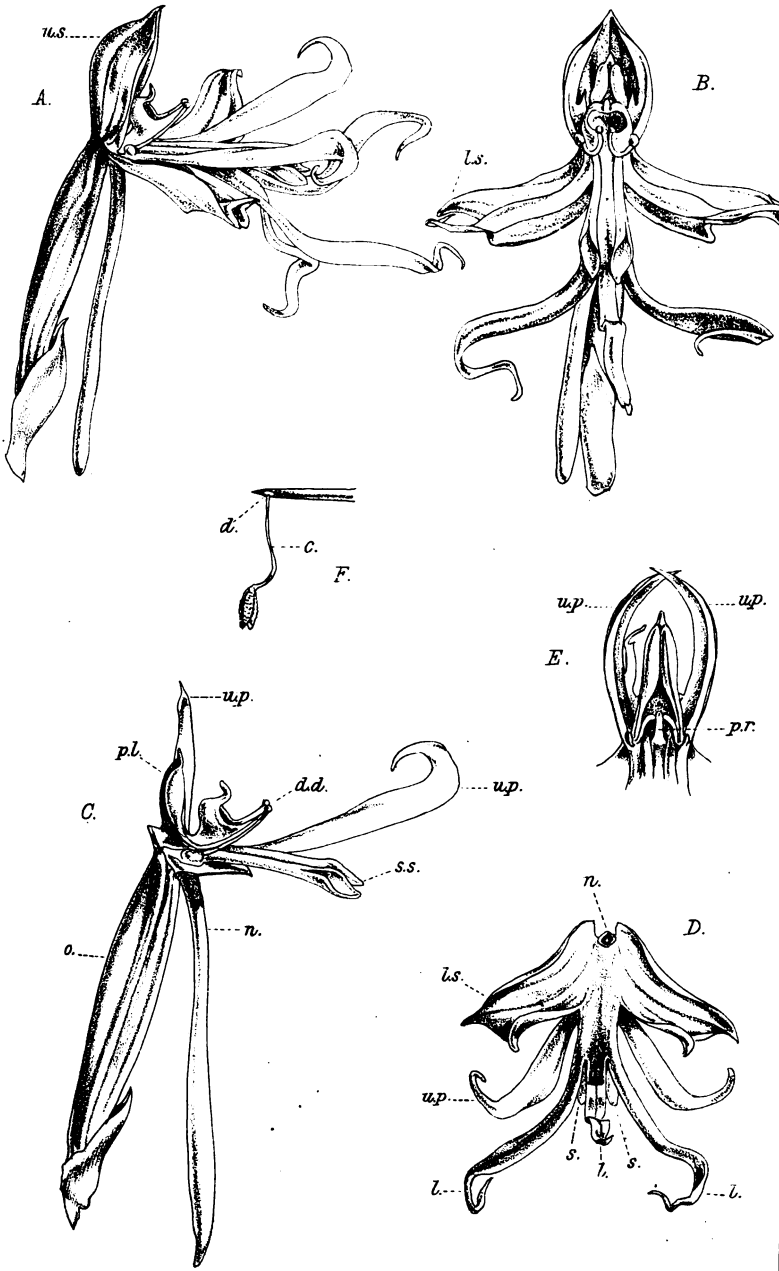
C. Side view of column, with all the sepals and petals removed except right upper petal.

D. Under surface of labellum, showing cohering lower sepals, and anterior limbs of upper petals which cohere with upper surface. (Apices of stigmatic processes visible on either side of central limb of labellum.)

E. Front view of portion of column (pollinia removed from anther-cells) with posterior limbs of upper petals attached, and rostellum cut away to show erect process of labellum preventing easy access to nectary.

F. Pollinium in its natural dependent position when attached by viscid disk to a pin and withdrawn from anther-case.

u. s. Upper sepal.
l. s. Lower sepals.
u. p. Upper petals.
l. Labellum.
n. Nectary.
o. Ovarium.
pl. Pollinia.
c. Caudicle of pollinium.
r. Rostellum.
dd. Viscid disks.
ss. Stigmatic surfaces.
pr. Process of labellum.



Bonatea speciosa. *Linn. Sp.*