

and yet related to a normally pentamerous? There must be some explanation of the transition from one form to the other, and I think that this unusual case of *Pentstemon* instanced by Braun himself serves reasonably to connect the two conditions.

*On the Mechanism for Fertilisation in the Flowers of  
Bolbophyllum Lobbii.* By GUSTAV MANN. (Plate III.)

(Read 14th July 1887.)

*Bolbophyllum Lobbii* was discovered in Java by Mr Thomas Lobb, and was named after him. This orchid is described in the *Botanical Magazine*, No. 4532. The flowers are said to be 4 inches across, yellow, shaded with cinnamon, spotted with light brown, and speckled outside with brown purple; but the flowers of the specimen I saw were not very conspicuous, the diameter being between 2 to 3 inches, while the colour was a dirty yellowish brown, with reddish-brown spots at the back of the perianth and on the internal surface of the upper part of the column, the latter being yellow near the stigmatic surface, while dirty white towards the prolongation carrying the labellum. The labellum was dirty yellow, but this colour was nearly obscured by a great number of small reddish-brown spots. The superior sepal had a few faint guiding lines of a brownish colour, all directed towards the pollinia. The guiding lines of the lateral petals were a little more distinct, while the two inferior sepals were attached halfway down the column, and exhibited each nine dark-brown guiding lines, which were also directed towards the pollinia and stigmatic surface. The spreading solitary flowers have a pleasant though not very strong smell.

The column (figs. 4 and 7) is prolonged downwards, forming a hook-like structure, at the apex of which is the labellum, and this column consists of the following parts:—

- (1) The anther case and pollinia.
- (2) Two lateral collar-like expansions, which surround the stigmatic surface.
- (3) The stigmatic surface proper.
- (4) The hook-shaped prolongation already mentioned.

The anther case is a lid-like structure containing the two pollinia, which in this case have no caudicle or viscid disc,

and each of which consists of two parts joined together like the two cotyledons in a bean.

The two lateral collar-like expansions are the two stamens of the inner whorl. This can be easily proved by making a transverse section of the column about the region of the stigma, when one finds, first of all, one bundle trace which belongs to the fertile stamen and two lateral traces belonging to the staminodes. The spiral vessels of the lateral traces are in the same position as the missing stamens of the inner whorl.

The stigmatic surface (fig. 7, *s*) in the newly expanded flower consists of a deep depression, at the basal margin of which is the viscid matter in the shape of two protruding drops, lying close side by side. In the upper half of the depression, two yet deeper depressions are to be seen, and these form the stigma proper. The two depressions are either for the two pollinia—but this, however, I don't consider likely, because the pollinia are removed singly—or for the two halves of one pollinium, which seems to be the right explanation, as will be shown afterwards.

The viscid matter is of great toughness, so that it is possible in rather old flowers to draw out threads 6 to 7 inches long. After the flower has been open for two or three days the viscid matter loses its drop-like appearance, and fills up the whole depression between the two collar-like expansions.

The hook-shaped prolongation of the column consists of the petiole of the inferior petal, and the filaments of the two remaining stamens of the outer whorl.

The heart-shaped labellum is fixed to the column by a thin neck (figs. 8 and 9), much compressed in the antero-posterior direction, and freely movable, only, however, from the horizontal position into a more or less vertical one. The thicker but short bilobed basal portion is directed towards the centre of the flower, while the apex hangs out as a tongue-like projection. The labellum is curved, more or less, like a half moon; the superior surface being hollowed out from side to side, and so distinctly concave. On the superior surface of the labellum near the base are three yellow spots; one larger than the others is situated in the middle line above and a little anterior to the junction of the labellum and the column, and the other two at the inner side of the posterior lobes.

With regard to the anatomical structure of the column

and labellum, the hook-like process of the column consists of ordinary rounded parenchymatous cells, some of them containing acicular crystals, and embedded in them are three tracts of spiral vessels. The cells become smaller and smaller towards the point of junction with the labellum, while the epidermal cells also become smaller; but they soon broaden out again in the labellum, and some of them have protuberances which further on get elongated, and the cells become stellate as in the Rush (fig. 3). It is also possible, as Mr Scott Elliot pointed out to me, to distinguish that the main axis of these cells are arranged parallel to the long axis of the labellum, that is to say, that if we would draw lines through the main axis of these cells, we would get lines radiating from a common point near the attachment of the column to the labellum. From the main axis of these cells there are from three to five projecting arms joining one cell with another.

The epidermis of the labellum also exhibits a very remarkable structure. The epidermal cells which are next the column have a corrugated appearance, the highest point of the cells being in the middle; but as one travels towards the apex, one finds the highest points of the cells becoming shifted more and more forward, until in the region of the larger yellow spot they come to form distinct bulgings pointing towards the apex of the labellum.

In general appearance these cells (fig. 2) strongly resemble those on the under surface of the lid of *Cephalotus*, the cuticle showing a striped appearance, the cells of one transverse row alternating with those of the next row. About the middle of the labellum, however, these downward-directed bulgings become less marked and less striped, while at the same time peculiar pit-like depressions make their appearance; these pits are directed upwards, and are formed in the following way:—

The epidermal cells alternate as already stated; now we have, say, between two cells of the upper row a cell of the lower row. The end of this cell, which is next the centre of the flower, is depressed or concave, while the other end projects slightly outwards, and is convex, forming the bulging, but in a less marked degree. The two halves of the upper cell roof over the concave depressed part of the lower cell, and thus a pit is formed, with its cavity directed towards the centre of the flower. Sometimes, however, three upper

cells correspond to one large cell below, and in this way we get a pit formed with two points directed upwards. The nearer we come to the apex of the labellum, the deeper are these pits, and in a preparation made by maceration of the epidermis with subsequent staining in anilin purple, these pits took up the colour, and had very much the appearance of upward-directed hairs, and it was only by making a vertical section through the labellum that I was able to make out the real structure.

At the yellow spots, already referred to, the cells contain a bright yellow colouring matter in the form of numerous granules. It is worth noting that the other cells of the labellum also contain this substance, but comparatively only few granules are to be found. Between the three yellow spots there is a tract of small oblong, delicately walled, slightly corrugated cells (fig. 1). The function of these I will afterwards return to. The cells on the under surface of the labellum also protrude, but only slightly, and not so much as those on the upper surface.

Now, I may state the function which those different parts perform in the fertilisation of the flower. Darwin mentions in his work on the Fertilisation of Orchids *Bolbophyllum cupreum*, *B. cocoinum*, *B. rhizophoræ*, and *B. barbigerum*; and he states that in *B. rhizophoræ* two pollen masses are fully exposed, and are attached by viscid matter, and that both are removed at the same time, and that in the same plant the stigmatic chamber, which is very deep, is fitted exactly by one of the two pollen masses. He states also that the sides of the oval orifice of the stigmatic chamber slope in after fertilisation, and so close the orifice completely, a fact which he did not observe in any other Orchid, and which he presumes is related to the exposed condition of the whole flower. Darwin does not specially mention the labellum, and only conjectures that the extreme flexibility of the labellum in *B. rhizophoræ* serves to attract the notice of insects.

When I first saw the flower of *B. Lobbii*, I came to the conclusion that the labellum had to perform the important function of tilting over and throwing the head or thorax of the insect first against the viscid matter, and then the insect would bring by its withdrawal the head in contact with the pollinia, and so remove at least one of them. To make sure,

however, I tried the following experiment:—I caught several humble bees, hive-bees, and different kinds of fly, including some blue-bottles, and put them along with the Orchid under a bell-jar, and watched them. For the first two hours the insects were rather excited, but after that they became quiet, and a hive-bee entered the flower first. It alighted on the labellum, and then moved towards the base of the labellum until its thorax came to the region of the first yellow spot, when suddenly the labellum tilted up, and the bee was thrown with the back part of the head and the thorax against the viscid matter, and by crawling backwards its head moved the anther case. I did not see the pollen masses removed, however, for I had used them for fertilising another flower in which the pollinia had been defective. The blue-bottle came next, alighted in the same way, and when it put out its proboscis to try whether the yellow spot contained something sweet, the labellum lost its balance, and came into a vertical position; this seemed to frighten the blue-bottle, and it quickly crawled backwards.

The stellate hairs of the labellum give it a certain strength, combined with lightness. The yellow colour of the three spots serves to draw the attention of insects to this particular place, and why we shall see shortly. While the epidermal bulgings at the same time prevent the insect from slipping, when the labellum is in a vertical position, in order to give the insect a sure foothold, the pit-like depressions are developed towards the apex of the labellum. It must be remembered that the claws of the two posterior pairs of an insect's legs are directed backwards, and being curved, will naturally go into the pits and help the insect to crawl back till the heavier parts of its body are outside the yellow spot in the middle line of the labellum, when, of course, the labellum will fall back into its horizontal position, and the pits being now directed upwards, the insect will have no difficulty in withdrawing its claws, and may fly to the next flower, where the same thing will happen over again, only with the difference that now one pollinium—or may be both pollinia—is pressed into the viscid matter of the stigma, and so fertilises the flower, while at the same time new viscid matter and the pollinia of the second flower will be attached to the insect's head.

There is no nectary in this flower, and it is my opinion

that, just as in the common English Orchids the cells of the spur contain a viscid matter which is sought after by insects, so in *B. Lobbii* the thin-walled cells, already alluded to (fig. 1), between the three yellow spots, contain a viscid substance which serves to attract insects; and this is still more probable from the fact that in another species whose name I have not been able to make out, certain cells are to be found at the same spot containing dense matter resembling somewhat the crystalloids in the leaf of *Ficus indica*, along with a red colouring matter; a portion of a section containing these bodies became yellowish brown when I tested by boiling in Fehling's solution.

In one flower which I had fertilised by bringing both pollinia on the stigmatic surface the following changes had after twenty-four hours occurred. The two lateral collar-like portions of the column, which I have already shown to be the filaments of the stamens of the inner whorl, together with the filaments of the fertile stamen, had become much swollen, the filaments of the fertile stamen curve forward to such an extent, that the anther case is carried downward, and the swollen filament shuts in the stigmatic chamber above, and forms the highest part of the column. The two lateral staminodes close in the stigmatic chamber from both sides. It is worth noting that I introduced both pollinia, but during this process of swelling, one of these was pressed out along with much viscid matter; therefore if an insect had introduced both pollinia as I did, the second one would in all probability be pressed out, and would easily be withdrawn should another insect enter the flower. Besides the changes in the column, changes in the perianth also occur: the superior sepal bends forward, and forms a sort of roof over the column, while at the same time the two lateral petals and the inferior sepals approach one another in front in such a way that the labellum becomes fixed in its usual position. The flower becoming in this way tubular, this latter process also takes place independent of fertilisation, when the flower is five or six days old and begins to wither. Even then fertilisation is possible by the insect penetrating deeply into the flower, and on crawling backwards removing viscid matter and the pollinia.

This closed-up condition also obviously protects the flower in a very beautiful way from any kind of injury.

## DESCRIPTION OF PLATE III.

- Fig. 1. *a*, thin-walled cells, acting instead of a nectary; *b*, hairs of middle yellow spot.  
 Fig. 2. Epidermis of labellum near apex, showing the pits. The dotted lines show position of down-directed hairs.  
 Fig. 3. Stellate tissue of labellum.  
 Fig. 4. Upper part of column in newly-expanded flower.  
 Fig. 5. Flower after fertilisation:  $p^1$ , outer,  $p^2$ , inner, whorl of perianth; *l*, labellum.  
 Fig. 6. Upper part of column, showing changes after fertilisation: *a*, anther case; *st.f*, fertile stamen; *st*, the staminodes; *v*, viscid matter; *p*, second pollen mass; *c*, column.  
 Fig. 7. Section of flower, lettering as in fig. 5: *a*, anther case; *v*, viscid matter; *s*, stigmatic surface; *st*, staminode; *c*, column.  
 Fig. 8. Labellum, from behind: *y.sp*, yellow spots.  
 Fig. 9. Labellum, viewed sideways.

*List of New and Rare Plants presented to the Herbarium of the Royal Botanic Garden.* By ARTHUR BENNETT, F.L.S., Croydon, and SYMINGTON GRIEVE, Edinburgh. Communicated by S. GRIEVE.

(Read 10th March 1887.)

The following plants have all been examined and named by Mr Arthur Bennett, and as they are of considerable interest, are worthy of preservation in the Herbarium at the Royal Botanic Garden:—

*Potamogeton prælongus*, Wulf., from the island of Rum, has only been previously recorded from Kirkcudbright, in the south-west, and not hitherto in any of the western counties of Scotland. It is common on the east coast.

*Carex flava*, var. *gauda* of Gay, from the island of Rum. If this plant is correctly named, this is the first record of it in Scotland. It has only previously been once recorded in Britain, having been collected on Snowdon many years ago. The specimen now exhibited has been compared with the Snowdon specimens preserved in Kew, and while Mr Bennett has little doubt as to its being the same plant, he cannot be perfectly certain, as the fruit is immature. In any case it is a remarkable form of *Carex flava*. Gathered by S. Grieve July 1884.

