On the Activity of the Glands of Byblis gigantea, Lindl.

BY

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Plants of *Byblis gigantea* grown in a plant-house of the Royal Botanic Garden, Edinburgh, at a temperature of between 50° and 60° C. were the subject of the following experiments which were carried out in the plant-house.

A large plant of *Byblis gigantea* was placed on the same stand as several plants of *Drosera* (of various species) and *Drosophyllum lusitanicum*. While the plants of these genera had caught respectively an almost equal number of flies, in no case large, there being only, in the case of *Drosophyllum lusitanicum*, five or six flies on a leaf about 15 cm. long, the plant of *Byblis gigantea* was smothered with flies, although it was smaller than the adjacent plant of *Drosophyllum lusitanicum*. On a single leaf of a plant of *Byblis gigantea* about 17 cm. long, I once counted remains of thirty-one flies. On young vigorously growing plants, where the leaves were only about 2·5 cm. long, I repeatedly counted from eight to twelve flies; and, on a small plant, the main stem of which was about 12 cm. long, and on which all the stalked glands were actively secreting, I counted remains of fifty-six flies. This shows what a very strong attraction the secretion from the stalked glands of *Byblis gigantea* has for flies, an attraction which seems to be greater than that in the secretion from the tentacles of *Drosera* and other members of the Droseraceæ hitherto described.

The glands of *Byblis gigantea*, which have been fully

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described by F. X. Lang,* are of two kinds: sessile glands arranged more or less in rows, and stalked glands, which are not so numerous as the sessile ones. The heads of the stalked glands are surrounded by a glistening drop of secretion, which is always absent from the sessile glands. Their secretion is neutral to litmus paper. In no case did I find an acid reaction. In being neutral it agrees with the secretion from the tentacles of *Drosera*, but differs from that of *Drosophyllum lusitanicum*, which is strongly acid. The head of the stalked glands does not contain any purple fluid. Darwin mentions as the outcome of his examination of dried specimens that "the glands of Byblis are purplish"; this I did not find to be the case in the living plant of *Byblis gigantea*.

Experiment I.

In order to determine if the tentacles possess the power of movement, I examined many tentacles to which insects were adhering, but was quite unable to discover any signs of inflection; nor was any sign of movement to be detected on irritating the tentacles with a needle nor on scratching or pricking the blades. This is what might have been expected, since the pedicel of the stalked glands is unicellular, and, according to Sachs, "no instance is known of any unicellular structure possessing the power of motion."

Experiment II.

A small cube of albumen about 1 mm. in size was placed on the sessile glands, and after 48 hours was completely surrounded by an acid secretion. On examining the cube with a lens, it was seen that the edges and corners had been rounded off. After three days, the cube was represented by a small round white spot in the centre of a drop of secretion. At the close of the fourth day, this white spot had become smaller, and next day had completely disappeared.

*F. X. Lang, Untersuchungen über Morphologie, Anatomie, und Samenentwicklung von *Polypompholyx* und *Byblis gigantea*, in Flora, lxxxviii(1901).

Experiment III.

A cube of albumen (about 2·5 mm. in length), slightly larger than that used in Experiment II., was placed on the sessile glands. After twenty-four hours a little secretion had been poured out, which after forty-eight hours was very much increased. On examining the cube at the end of the fourth day, it was found that the lower edges and corners had been rounded off. After six days the cube had sunk down on to the surface of the leaf, and the upper edges and angles were rounded off. Two days later the cube had become more or less round. At the close of the eleventh day the remains of the cube were found lying on the surface of the leaf quite dry, the whole of the secretion having been absorbed.

Experiment IV.

A small cube of albumen just under 1 mm. in size, which had just been removed from an egg, and thus was moist, was placed on the sessile glands, and after two days had been completely dissolved.

Experiment V.

A cube of albumen of a little over 1 mm. in size was cut from the top of an egg which had been kept for about two days. This cube was carefully dried so as to remove all traces of moisture and was then placed on the sessile glands so that it did not come into contact with the secretion from the stalked glands. This cube was examined at the end of the first, second, third, fourth, and fifth days, and after this time, examination with a lens showed that the edges and angles had not been rounded off, and it was not surrounded by a drop of secretion.

Experiment VI.

Small fragments of broken glass were placed on the sessile glands which were observed every day for a week; by the end of the period no secretion had been poured out.

Experiment VII.

A drop of a dilute solution of carbonate of ammonia was placed on the sessile glands, which after twenty-four hours became darkened, owing to the salt having been absorbed. On looking at the glands several days afterwards they had quite lost their black colour, showing that they had not been killed.

These experiments show that the sessile glands of *Byblis gigantea* possess the power of digestion. This power, however, seems to be limited, since if the piece of albumen is too large, it is not all digested. This might, however, be due to the white of egg absorbing so much of the moisture into itself, that the glands are injured and unable to continue resecreting.* The secretion from the sessile glands differs from that of the stalked glands in being acid to litmus. The sessile glands do not secrete spontaneously, a fact which is shown since particles of glass did not bring forth any secretion, neither did a perfectly dry piece of albumen. If, however, the albumen is moist and contains a little soluble nitrogenous matter, this causes the glands to pour forth immediately their secretion, which is acid, and is able to digest animal substances. The soluble nitrogenous matter which is required to cause the glands to secrete probably enters the gland by osmosis through the cell-wall, since if the albumen is fresh, the secretion is poured forth quickly, and the cube of albumen is rapidly dissolved. If the cube is not quite so fresh, it will have dried up to a certain extent, and there will not be so much soluble nitrogenous matter, so that the osmosis will not take place quite so quickly, the glands will take longer to be stimulated, and will, in consequence, not pour out their secretion so quickly, and this is exactly what I found to be the case. If, on the other hand, the albumen is completely dried there will be no nitrogenous material present in solution, the glands will not be stimulated, and no secretion will be poured out.

After the secretion has digested the animal remains, the dissolved matter is absorbed by the glands, as is shown by their

* Compare the effect described later of placing too large pieces on the stalked glands.

becoming dry, and by the aggregation of their protoplasmic contents with carbonate of ammonia. The sessile glands do not contain any red colouring matter.

Experiment VIII.

Experiments upon the secretion of stalked glands are much more difficult to carry out successfully on *Byblis gigantea* than on *Drosophyllum lusitanicum*, owing to the drop of secretion from the stalked glands of *Byblis gigantea* being much smaller; and further, as the glands are not very close to each other, it is not easy to place a small cube of albumen so as to rest on several of them at the same time.

A small cube of albumen was placed on one of the stalked glands, which was examined twenty-four hours later. The cube was then found lying on the gland, and not surrounded by secretion. This was due to the fact that the albumen had absorbed the moisture of the drop, which thus became quite dry, and as it did not resecrete so long as the cube was lying on it, the gland was probably slightly injured.

Experiment IX.

A small cube of albumen, about half the size of that used in Experiment VIII., was placed on one of the stalked glands, and, after twenty-four hours, the secretion was not absorbed. At the end of two days the cube had become transparent, but there were no signs of any rounding off of the edges or angles. After four days it was still surrounded by secretion, and, as it was not digested by the end of the fifth day, I removed it and placed it on the sessile glands below. which quickly poured forth their acid secretion and completely digested it.

This experiment shows that the secretion from the stalked glands has not the power of digestion.

When an insect alights on one of the leaves, it first comes in contact with the drops of secretion on the heads of the stalked glands (which continually secrete). It is held by the secretion of these glands. In its efforts to escape, however, it moves across the leaf, and thus comes in contact with the secretion from neighbouring glands. It ultimately becomes so surrounded by the secretion that it is suffocated, and falls down helpless on to the sessile glands below, which after a short time pour forth their secretion, and after digestion of the remains, the soluble matter is absorbed.

I saw flies caught by the plant in this way. The secretion from the stalked glands is in the form of round drops, which are easily removed on touching the gland with a needle, and are so viscid that they may be drawn out into thin threads many centimeters long.

The above record of experiments upon the activities of the glands of *Byblis gigantea* discloses a parallel with the activity of the glands of *Drosophyllum lusitanicum*. In *Drosophyllum* the glands are of two kinds, stalked and sessile; the sessile glands do not secrete unless stimulated, when they pour out their digestive secretion and afterwards absorb the digested matter. The stalked glands continually secrete, are not digestive, and are chiefly useful to the plant for catching insects. But whilst there is this functional parallel the construction of the gland is different in the two plants.

It seems to me to be probable that the sessile glands of *Drosophyllum lusitanicum* have been derived from the stalked glands by the loss of the pedicel; while in the case of *Byblis gigantea*, it is possible that the opposite is the case, namely, the stalked glands have been derived from the sessile ones, since the pedicel is unicellular, and might be considered to have arisen by the elongation of the single cell which corresponds to it in the sessile glands.