ORCHIDACEÆ.

This order is the subject of Mr. Darwin's admirable work, "On the Various Contrivances by which British and Foreign Orchids are fertilised by Insects," from which the following facts are taken. The order contains sixteen British genera, several of them extremely curious and pretty. The species with long nectaries are fertilised by Lepidoptera, those with shorter ones, as a general rule, by bees and flies; *Epipactis latifolia*, it is said, exclusively by wasps, so that, according to Darwin, "if wasps were to become extinct in any district, so would the *Epipactis latifolia*." Other species on the contrary such as *Epipactis viridifolia*, and *Ophrys apifera* (the Bee Orchis) habitually fertilise themselves. It is remarkable that in some Orchids the ovules are not developed until several weeks, or even months, after the pollen tubes have penetrated the stigma. (Hildebrand, *Bot. Zeit.*, 1863 and 1865. Fritz Müller, *Bot. Zeit.*, 1868.)

The flower in this order is very abnormal. There is, except in Cypripedium, only one anther, which is confluent with the style, forming the so-called "column." The anther is divided into two cells, which are often so distinct as to appear like two separate anthers. The pollen in most Orchids coheres in masses, which are supported by a stalk or "caudicle;" the pollen masses with their stalks are called "pollinia." The styles are theoretically three in number; but the stigma of the upper one is modified into a remarkable organ called the

"rostellum," and those of the two lower ones are often confluent, so that they appear like one.

Orchis mascula (Fig. 120) is perhaps our commonest species.

Fig. 121 represents the side view of a flower from which all the petals and sepals have been removed, except the lip (*l*) half of which has been cut away, as well as the upper portion of the near side of

FIG. 120.—*Orchis mascula.*

the nectary (*n*). The pollen forms two masses (Figs. 121, 122*a*, and 123), each attached to a tapering stalk, which gives the whole an elongated pear-like form, and is attached to a round sticky disk (Fig. 123*d*), which lies loosely in a cup-shaped envelope or rostellum (*r*). This envelope is at first continuous, but the slightest touch causes it to rupture transversely,

and thus to expose the two viscid balls (*dd*). Now suppose an insect visiting this flower: it alights on

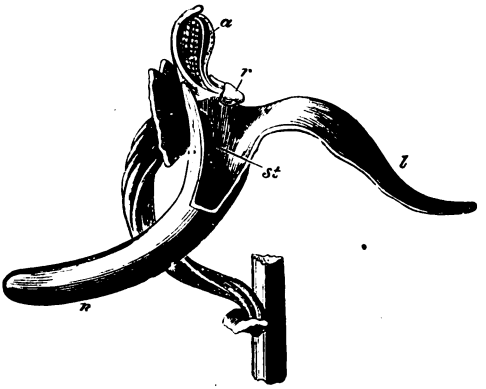

FIG. 121.

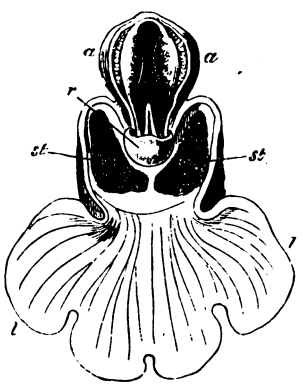

FIG. 122.

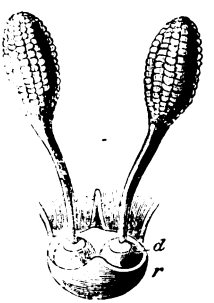

FIG. 123.

FIG. 121.—Side view of flower, with all the petals and sepals cut off except the lip, of which the near half is cut away, as well as the upper portion of the near side of the nectary.

FIG. 122.—Front view of flower, with all sepals and petals removed except the lip.

FIG. 123.—The two pollinia.

the lip (*l*), and pushing its proboscis down the nectary to the honey, it can hardly fail to bring the

base of the proboscis into contact with the two viscid disks, which at once adhere to it, so that when the insect draws back its proboscis, it carries away the two pollen masses. It is easy to imitate this with a piece of grass, and to carry away on it the two pollen masses and their stalks. If, however, the pollinium retained this erect position when the insect came to the next flower, it would simply be pushed into or against its old position. Instead, however, of remaining upright, the pollinia, by the contraction of the minute disk of membrane to which they are attached, gradually turn downwards and forwards, and thus when the insect sucks the next flower, the thick end of the club exactly strikes the stigmatic surfaces (*st st*). The pollinium or pollen-mass consists of packets of pollen grains, fastened together by elastic threads. The stigma, however, is so viscid, that it pulls off some of these packets, and ruptures the threads, without removing the whole pollinium, so that one pollinium can fertilise several flowers.

This description applies in essentials not only to *Orchis mascula*, but also to *O. Morio*, *O. fusca*, *O. maculata*, and *O. latifolia*, as well as to *Aceras anthropophora* (the Man orchis), in all of which the pollinia undergo, after removal from the anther cells, the curious movement of depression, which is necessary in order to place them in the right position to strike the stigmatic surface.

O. pyramidalis differs from the above group in several important points. The two stigmatic surfaces are quite distinct, and the rostellum is brought down, so as to overhang and partly close the entrance to the

nectary. The viscid disks which support the pollen masses, are united into a single saddle shaped-body. The lower lip is furnished with two prominent ridges, which serve to guide the proboscis of the insect into the orifice of the nectary. It is of course important that the proboscis should not enter obliquely, for in that case the pollen masses would not occupy exactly the right position.

Following Darwin and other botanists, I have applied to the spur of Orchis the term "nectary." As a matter of fact, however, the flowers of this genus produce no honey; whence Sprengel applied to them the term "Scheinsaftblumen" or "Sham-honey-flowers." Darwin does not, however, think that moths (by which the flowers of this group are principally fertilised) could be so deceived for generation after generation; and as he has observed that the membrane of the interior of the spur is very delicate, and the cellular tissue extremely juicy, he suspected that insects possibly pierce the membrane, and suck the juicy sap lying beneath. His suggestion has been confirmed by H. Müller, and he himself in a subsequent memoir (*Ann. and Mag. of Nat. His.*, 1869, p. 143) speaks confidently on the point.

The flowers belonging to the genus Ophrys are formed somewhat on the same plan as those of Orchis, but they have no spur, and the rostellum is double. The Bee orchis (*O. apifera*), Fig. 124, however, differs widely from the other allied British species. The two pouch-formed rostellums, the viscid disk, and the position of the stigma, are nearly the same, but the stalks of the pollen masses are long, thin, flexible,

and too weak to stand upright. The distance of the pollen masses from one another, and the shape of the pollen grains is moreover variable. The anther cells open soon after the flower expands, and the pear-shaped pollen masses drop out, so as to hang directly over the stigma, with which a breath of air is sufficient to bring them in contact. While therefore in most species of Orchis and Ophrys, self-fertilis-

FIG. 124.—*Ophrys apifera.*

ation appears to be impossible, in the Bee Ophrys, as R. Brown long ago pointed out (*Trans. Linn. Soc.*, v. xvi.) it is carefully provided for. Darwin has examined hundreds of flowers, and has never seen reason in a single instance to believe that pollen had been brought from one flower to another; and he has met with very few cases in which the pollen mass

failed to reach its own stigma. He has never seen an insect visit the flowers of this species, and R. Brown suggested that the resemblance of the flower to bees was to deter insects from visiting them. Darwin does not think this probable. He believes also that, though this species habitually fertilises itself, the curious arrangements which it possesses in common with other allied species, are of use in securing an occasional cross, even if only at very long intervals.

Ophrys arachnites is by some botanists (for instance by Bentham) regarded as a mere variety of *O. apifera*, but the stalks of the pollen masses are not much more than half as long, without any diminution of thickness. In proportion, therefore, and in their stiffness, they more nearly resemble the other section of the group. Mr. Moggridge, however, has found at Mentone intermediate forms, not only between *O. arachnites* and *O. apifera*, but also between these, *O. aranifera* and *O. Scolopax*. *O. arachnites* and *O. apifera* do not in England appear liable to pass into one another.

In the Musk orchis (*Herminium monorchis*), the stalks of the pollen masses are short, and the disks large. This species does not produce honey, but has a strong odour, especially at night.

Habenaria chlorantha (the Large Butterfly orchis) has both a sweet scent and honey. It is much frequented by insects. The anther cells are widely separated; the pollinia slope backwards, and are much elongated; the viscid disk is circular, prolonged on its imbedded side into a short, drum-like pedicel.

When exposed to the air this drum contracts on one side, and alters the direction of the pollen mass, thus bringing it (as in *Orchis mascula*) into such a position that it comes in contact with the stigmatic surface of the flower to which it is carried.

Habenaria bifolia (the Lesser Butterfly Orchis) is by Bentham and other high authorities, considered as a mere variety. Yet, as Darwin points out, it differs

FIG. 125.—*Cephalanthera grandiflora*

in many important particulars. The viscid disks are oval; the viscid matter itself is of somewhat different character; the drum-like pedicel is rudimentary; the stalk of the pollen mass is much shorter; the packets of pollen shorter and whiter; and the stigmatic surface more distinctly tripartite.

The genus Cephalanthera (Fig. 125, *Cephalanthera*

grandiflora) differs from those hitherto described in not possessing a rostellum, and in having the pollen grains single. The flower stands upright, and the labellum is formed of two portions; a base, and a small triangular flap, which at first closes the tube; then turns back, thus forming a small landing place in front of a triangular door, situated half way up the tube; and lastly rises up again and closes the

FIG. 126.—*Listera ovata.*

entrance. The pollen mass is situated just above the stigma; and while the flower is in bud, or at any rate before it becomes quite open, the pollen grains which rest on the sharp edge of the stigma, emit a number of tubes which deeply penetrate the stigmatic tissue. These serve partially, but, as Darwin has shown, only partially, to fertilise the flower; he suggests that the principal use of this closing of the

flower and emission of the pollen tubes is probably to retain the pollen, which would otherwise fall out of the flower. In this curious manner, however, they are retained in a proper position until the flower is visited by insects, to which they readily adhere; and which are necessary to ensure the perfect fertility of the plant.

Listera ovata (the Twayblade, Fig. 126) has been carefully described by Sprengel, by whom the structure and action of the rostellum was, however, misunderstood, and by Dr. Hooker (*Philosophical Transactions*, 1854), who described the flower with accuracy and minuteness; but the relations of the flower to insects, and consequently the true functions of the various parts, were first perceived by Darwin. The pollen masses lie immediately above the rostellum; the pollen is friable and would not of itself adhere to insects, but this is effected by a very remarkable contrivance (see Hildebrand, p. 53). The moment the summit of the rostellum is touched, it expels a large drop of viscid fluid, which glues the pollen to the insect or other body. A very slight touch, even for instance with a human hair, is sufficient to produce this remarkable phenomenon.

Neottia nidus avis (the Bird's Nest Orchis) agrees in the essential points with Listera, though in the position of the honey, &c., it offers minor differences.

Cypripedium (the Ladies' Slipper, Fig. 127 and 128, *C. longifolium*), the lower lip has the form of a slipper, whence the name. This genus has two fertile anthers, which are rudimentary in other Orchids, while the one which is present in them is represented

by a singular shield-like body. The opening into the slipper is small, and partly closed by the stigma and this shield-like body, which lies between the other two anthers. The result is that the opening into the slipper has a horseshoe-like form, and that bees or other insects which have once entered the slipper (Figs. 127–8) have some difficulty in getting out again. While endeavouring to do so they can hardly fail to come in contact with the

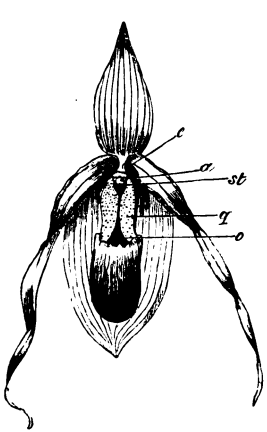

FIG. 127.—Flower of *Cypripedium longifolium*. Front view.

FIG. 128.—Ditto. Seen from the side.

stigma, which lies under the shield-like representative of the middle anther. As the margins of the lip are inflected (Figs. 127–8*q*), the easiest exit is at the two ends of the horseshoe, and by one or other of these (Fig. 127 *e*) the insect generally escapes, in doing which, however, it almost inevitably comes in contact with, and carries off some of the pollen, from the corresponding anther. The pollen

of this genus is immersed in a viscid fluid, by means of which it adheres firstly to the insect, and secondly to the stigma, while in most Orchids it is the stigma which is viscid. In a Trinidad species, *Coryanthes macrantha*, according to Dr. Cruger, the basal part of the lip forms a bucket, which secretes a copious fluid which wets the wings of the bees, and by rendering them temporarily incapable of flight, compels them to creep out through the small passages close to the anther and stigma; thus securing, though by different means, the object which in Cypripedium is effected by the inflected margins of the labellum. (*Jour. Linn. Soc.*, 1864.)

Such are a few of the remarkable contrivances existing among British Orchids. I must refer those who wish for more detailed information, to Mr. Darwin's charming work.

Although I have thought it well to confine myself for the most part to illustrations taken from our common wild flowers, I cannot resist mentioning the case of Catasetum, one of the Vandeæ, which as Mr. Darwin says, are "the most remarkable of all Orchids." In Catasetum, the pollinia and the stigmatic surfaces are in different flowers, hence it is certain that the former must be carried to the latter by the agency of insects. The pollinia moreover are furnished with a viscid disk, as in Orchis, but the insect has no inducement to approach, and in fact does not touch, the viscid disk. The flower, however, is endowed with a peculiar sensitiveness, and actually throws the pollinium at the insect. Mr. Darwin has been so good as to irritate one of these flowers in my

presence: the pollinium was thrown nearly three feet,

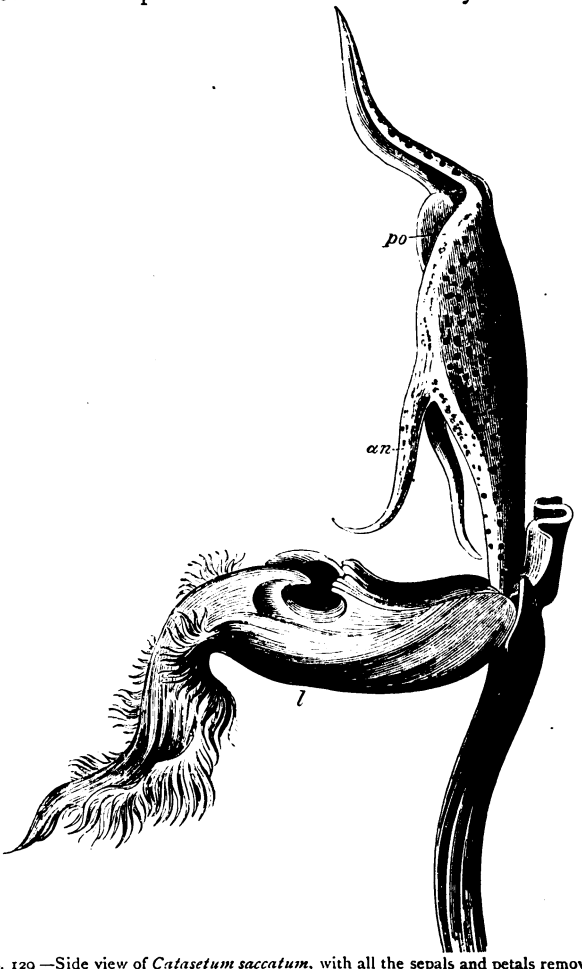

FIG. 129.—Side view of *Catasetum saccatum*, with all the sepals and petals removed except the labellum.

when it struck and adhered to the pane of a window.

This irritability, however, is confined to certain parts of the flower. Fig. 129 represents a male flower of *Catasetum saccatum*, which is also shown in section in Fig. 130. In this figure it will be seen that the pollinium (*ped*) is curved and in a state of considerable tension, but retained in that position by

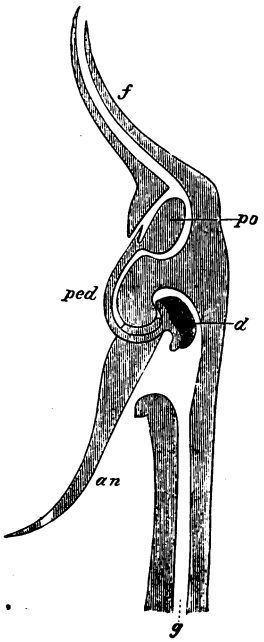

FIG. 130.—Section of ditto, with all the parts a little expanded.

a delicate membrane. Now insects alight as usual on the lip of the flower (*l*), and it will be seen that in front of it are two long processes called antennæ (*a n*). In some species of Catasetum both these antennæ are

highly irritable; in the present species the right-hand one is apparently functionless; but the moment the insect touches the left-hand one, the excitement is conveyed along it, the membrane retaining the pollinium is ruptured, and the latter is immediately jerked out of the flower, by its own elasticity, with considerable force, with the viscid disk (*d*) foremost, and in such a direction as to come in contact with the head of the insect which had touched the antenna. On subsequently visiting a female flower the insect brings the pollen into contact with the stigma.

AMARYLLIDEÆ.

This beautiful order contains three British genera; Narcissus, Galanthus (the Snowdrop), and Leucoium.

The Snowdrop is probably not a true native of this country, but has long been naturalised in many parts. It is sweet scented, and melliferous; as the flower hangs down, the honey is perfectly protected from rain by the leaves of the perianth. The flower remains open from about ten in the morning till four in the afternoon, when it closes for the night. The pistil is white, except at one part a little above the middle where it is tinged green, a character more marked in the next genus, Leucoium.

IRIDEÆ.

We have five British genera of this group; Iris, Gladiolus, Sisyrinchium, Trichonema, and Crocus.

Iris pseudacorus L. secretes honey. It is fertilised by humble bees, and according to Müller, still more frequently by Rhingia. The flowers are large and showy, the three outer perianth-segments large, spreading and reflexed, the three inner ones much smaller and erect. The stigmas are three in number, enlarged, and each with an appendage resembling a petal, which arches over the corresponding stamen and outer segment of the perianth. In order to reach the honey, insects have to force their way between this segment and the over-arching stigmatic leaf.

DIOSCORIDEÆ.

The Yam family contains but one British genus, Tamus; with one species, *Tamus communis* (Black Bryony). A pretty, straggling creeper, dicœcious, with small, yellowish green flowers; the male in laxer, the female in closer, racemes.

LILIACEÆ.

This order contains seventeen British genera, including the Lily, Onion, Tulip, Colchicum, Asparagus, Solomon's Seal, Fritillaria, Lily of the Valley, Butcher's Broom (Ruscus), &c.

Paris quadrifolia is proterogynous. The perianth is yellowish green, and produces no honey. The structure of this curious flower has not I think been satisfactorily explained.

The Lily of the Valley (*Convallaria majalis*) is likewise honeyless, but is much visited by Hive bees for the pollen.

Allium ursinum is melliferous, and imperfectly proterandrous; *Lloydia serotina*, on the contrary, is said by Ricca to be very decidedly so.

Hyacinthus orientalis produces no honey, but the fleshy base of the flower is pierced by some insects for the sake of the sap.

The Common Asparagus is a cultivated variety of *A. officinalis*, which grows on maritime sands, or sandy plains, in central and western Asia, and on the south European coasts up to the English Channel. The flowers are melliferous, small, greenish white, on slender stalks two or three together in the axils of the branches. The species is particularly interesting, as an instance of an unisexual flower, which is evidently descended from bisexual ancestors; since the male flowers contain a rudimentary style, the female flowers rudimentary stamens. In accordance with Sprengel's rule, the male flowers are distinctly larger than the female, being about six mm. long, while the female are only three mm. long.

Colchicum autumnale is proterogynous, though the stigma is still capable of fertilisation when the anthers ripen. Honey is secreted by the base of the stamens.

JUNCACEÆ.

We have two genera belonging to the Juncaceæ (Rushes). Juncus (the Rush), with fourteen species; and Luzula (the Woodrush) with five. They are wind-fertilised, and, at least as regards some species, are proterogynous.

CYPERACEÆ.

The Cyperaceæ (Sedges) are a very numerous group containing eight British genera. The flowers are minute, greenish or brownish, and wind-fertilised, but are sometimes visited by insects for the sake of the pollen.

GRAMINEÆ.

The order Gramineæ (Grasses) is very extensive, containing more than forty British genera. They are, however, wind-fertilised.

This is the last order which I have to mention. Those who have done me the honour to read so far, will not need to be told that this little book is fragmentary and incomplete. For my own part, I am only too sensible of it. Nevertheless, the fault is not altogether mine. Our knowledge of the subject is as yet in its infancy; and indeed, my great object has been to bring prominently before my readers how rich a field for observation and experiment is still open to us. Most elementary treatises unfortunately, though perhaps unavoidably, give the impression that our knowledge is far more complete and exact than really is the case. This naturally tends to discourage, rather than to promote, original observations. Few, I believe, of those who are not specially devoted to zoology and botany have any idea how much still remains to be ascertained with reference to even the commonest and most abundant species. In the present case, I have confined myself to the consideration of Flowers in relation to Insects. The interesting adaptations presented by such forms as the grasses,

conifers, &c., which are fertilised by the action of the wind, did not therefore come within my subject.

The causes which have led to the different forms of leaves have been, so far as I know, explained in very few cases: those of the shapes and structure of seeds are tolerably obvious in some species, but in the majority they are still entirely unexplained; and even as regards the blossoms themselves, in spite of the numerous and conscientious labours of so many eminent naturalists, there is no single species as yet thoroughly known to us.