CHAPTER IV.

Darwin on the fertilization of orchids—Some orchids fertilized by particular insects only—Case of the Angrœcum sesquipedale and of the Coryanthes Macrantha—Abundance of orchid seed and scarcity of seedling plants—Duke of Argyle's Reign of Law—Admits evolution of species under a guiding will—The organs of reproduction of orchids a proof of this—Mr Wallace's observation upon this point—Humming-birds—Mr Wallace's observations upon the Reign of of Law—The Duke of Argyle's reply—The peculiarity of organs of reproduction of orchids not the result of natural selection—Owen's comparative anatomy—Fossil ancestors of the horse—Bucephalus—Extinct corals—Owen's views as to derivation—Mr Darwin's animals and plants under domestication—As to the stability of variations—Cross-bred rats—Different degrees of variability—In what sense variations are accidental—Reference to fragments fallen from a cliff—Asa Gray's point that variation has been divinely directed.

We come now to Mr Darwin's work on the fertilization of Orchids, his object evidently being to show that the extraordinary structure of the flowers of these plants was beneficial to them, and thus to meet to some extent the objections made to the theory of natural selection, from the fact that there

are in nature many structures which have been created for the sake of beauty and variety.

The pollen masses of almost all orchideous plants are enclosed in sacks in such a manner that the pollen cannot be shaken on to the stigma, nor the flowers fertilized by insects in the usual manner. But there are many special contrivances by which the pollen is made to adhere to the tongues of insects in such a manner and position, that though they do not fertilize the flower from which they take the pollen, they must with that pollen fertilize any other flower of the same kind which they may visit.

There are some very curious points connected with this plan for the fertilization of the flowers of orchids; namely, in some of them, the nectary which should secrete the honey to attract the insects is entirely dry, containing no honey whatever, insomuch that a German Naturalist, knowing that fertilization by insects is indispensable to these plants, believes that they exist by an organized system of deception. Mr Darwin does not agree with him, having too good an

opinion of the judgment of moths to suppose that they would be attracted by an empty nectary, and he is inclined to believe that the nectaries of these plants secrete honey internally, and that the moths have some means of piercing through the membrane with which this honey is covered. It is certainly a most remarkable circumstance, that any impediment should be placed in the way of the action of insects when of such great importance to the plant. Mr Darwin seems to think that the time required by the moth to pierce the membrane may be of advantage to the process of collecting the pollen. But this fact, and that of the moths being able to pierce the membrane at all, are, he allows, very doubtful cases.

We may observe that the adherence of the pollen masses to the tongues of the moths is a great discomfort to them, the pollen masses are so viscid that the insects cannot free themselves from them. Mr Darwin gives a figure of the tongue of a moth with eleven pollen masses adhering to it, and states that, thus encumbered, it could not have reached the extremity of the nectary, and must have

starved to death. If such cases were of ordinary occurrence, we should suppose moths would become aware of their danger, and avoid such flowers, so that the contrivances for effecting their fertilization might seem to counteract themselves.

Another point is that the bee orchis, and almost only the bee orchis, is capable of self-fertilization, certainly a most remarkable exception to the general polity of the tribe; is it for the good of the plant or to its disadvantage?

'In the Angræcum sesquipedale, of which the large six-rayed flowers, like stars formed of snow-white wax, have excited the admiration of travellers in Madagascar, a whip-like green nectary of astonishing length hangs down beneath the labellum.' In several flowers grown in England, Mr Darwin found the nectaries eleven and a half inches long, with only the lower inch and a half filled with very sweet nectar.

Mr Darwin found that to effect the fertilization of this plant, it must be visited by very large moths, with a proboscis thick at the base, and that this proboscis would have

to be thrust in as far as possible, even by the largest moths, before they could withdraw the pollen masses attached to their probosces, and that only such moths, on repeating the same action in another flower, could leave these masses on the stigma, and fertilize it. If the angrœcum in its native forests secretes more nectar, so that the nectary becomes filled, small moths might obtain their share, but they would not benefit the plant. The pollen masses would not be withdrawn until some huge moth with a wonderfully long proboscis tried to drain the last drop. If such great moths were to become extinct assuredly the Angrœcum would become extinct. On the other hand, as the nectar, at least in the lower parts of the nectary, is in fact preserved for these great moths safe from other moths, the extinction of the Angrœcum would probably be a serious loss to these very large moths.

We can now, says Mr Darwin, thus partially understand how the astonishing length of nectary may have been acquired by successive modifications. As certain moths of Madagascar became larger through natural

selection, those individual plants of the Angrœcum which had the longest nectaries (and the length of the nectary varies much in some orchids), and which consequently compelled the moths to insert their probosces up to the very base, would be best fertilized. Those plants would yield most seed, and the seedlings would generally inherit larger nectaries, and so it would be in successive generations of the plant and moth. Thus it would appear that there has been a race in gaining length between the nectary of the Angrœcum and the probosces of certain moths, but the Angrœcum has triumphed, for it still flourishes and abounds in the forests of Madagascar, and still troubles each moth to insert its proboscis as far as possible to drain the last drop of nectar. The reader will perhaps feel inclined to ask when is this race to cease ?

Another case is that of Catasetum saccatum, which, on certain parts of the flower being tickled, shoots out its pollinia with such violence, that on one occasion they stuck upon a pane of glass three feet distant from the plant. They are thus capable of

giving a bee so sharp a blow, that he might be immediately inclined to leave the flower, and try another one to which he would carry the pollen masses.

We will mention one other case, as in the sequel we shall find it the most curious of all. In the flower of an orchid, named Coryanthes Macrantha, are two little horns which secrete so much nectar that it slowly drops down; one flower will secrete about an ounce (at least half a wine-glass full). The deeply hollowed end of the labellum hangs some way down beneath the two little horns, and catches the drops that fall from them, just like a bucket suspended some way beneath a dropping spring of water.

When Mr Darwin wrote his account of the fertilization of orchids, the particular manner in which this curious mechanism was employed in ensuring the fertilization of the flowers was not known. In a recent edition of his 'Origin of Species,' Mr Darwin gives an account of this manner, and a most curious account it is; we give it here as more immediately connected with this part of our subject; we shall often have to refer to it. 'When the

bucket, into which drops of nectar (almost pure water) fall from the two little secreting horns above it, is half full, the water flows over by a spout in the side, the basal part of the labellum stands over this bucket, and is itself hollowed out into a sort of chamber with two lateral entrances. The most ingenious man, says Mr Darwin, if he had not witnessed what takes place, could never have imagined what purpose all these parts serve. But Dr Crüger saw crowds of large humble-bees visiting the gigantic flowers of this orchid, not to suck nectar, but to gnaw off the ridges within the chamber above the bucket. In doing this, they frequently pushed each other into the bucket, and their wings being thus wetted they could not fly away, but were compelled to crawl out by the spout. Dr Crüger saw a continual procession of bees thus crawling out of their involuntary bath. The passage is narrow, and is roofed over by the column, so that a bee, in forcing its way out, first rubs its back against the viscid stigma, and then against the viscid glands of the pollen masses; the pollen masses are thus glued to the back of the bee which first

happens to crawl out of a lately expanded flower, and are thus carried away. Mr Darwin had sent to him in spirits a flower with a bee which had been killed before it had quite crawled out, with a pollen mass still fastened on its back. When the bee thus provided flies to another flower, *or to the same flower a second time*, and is pushed by its comrades into the bucket, and then crawls out by the passage, the pollen mass necessarily comes first into contact with the viscid stigma and adheres to it, and the flower is fertilized.'

In treating of the nectar-producing organs of orchidaceous plants, Mr Darwin remarks, that in nearly all the flowers of Angrœcum distichum which had been sent him from Kew, insects had bitten holes through the nectaries so as to get more readily at the nectar. If insects, says Mr Darwin, were invariably to follow this bad habit in the plants' native African home, it would soon become extinct, for it would never produce any seed.

It will probably strike the reader that it is not likely that the insects of Africa should be

so much behind those of Europe in instinct as to neglect this easy mode of obtaining their food, considering the habit which our humble-bees have of biting holes into the nectaries of all flowers to which they cannot get easy access. Every gardener knows how they spoil his heaths; we cannot doubt that many if not all the flowers of the Angrœcum are bitten in their native homes, and we are almost inclined to think that there must be some simpler mode of fertilizing these flowers than that so graphically described by Mr. Darwin, who does not seem to think that moths are so simple as to visit an empty nectary.

The advantage to be gained on the utilitarian principle by all these curious contrivances is, that each flower should not be set with its own pollen, but with that of another bloom, a circumstance which is supposed to produce abundant and vigorous seed. Now, in the first place, one orchid, the bee orchis, does not possess this advantage, as we have seen. It is not one of the most common of orchids, but on a soil which suits it, chalk or limestone, it is tolerably abundant, and

would probably be more so, if it were not so much sought after by collectors. It is certainly much more plentiful than many of our native species, which cannot, according to Mr Darwin, be fertilized by their own pollen; and we must here remark that in the very curious case of the Coryanthes, where the machinery is the most elaborate of all, there is no security, scarcely a probability, that each flower should be fertilized by the pollen of another. We see in this case that the bee may return to the flower to which it first went, and whose pollen mass is sticking to its back; it is evidently most likely that it would do so, as this flower would be the nearest to it, and it would naturally like to return to the banquet from which it had just been driven, and thus the flower will be fertilized with its own pollen. The case is different from that of a bee or moth seeking honey and leaving an exhausted flower, as they would not probably repeat their visit to a flower when they had sucked the nectar, but here there seems sufficient attraction in the prominent ridges to draw troops of bees to the same flower. How, then, could this

elaborate machinery have been formed by natural selection, since the seed is not improved by it? We shall soon see other reasons why this structure cannot be due to natural selection.

There is yet another point connected with this subject which is remarkable. Mr Darwin mentions the amazing number of seeds produced in one capsule; he found six thousand two hundred in one capsule of Orchis maculata, and there were thirty capsules on the same plant, giving a total of 186,300 seeds. As this orchid, he says, is perennial and is not in most places increasing in number, one seed alone of this large number once in every few years can produce a plant.

It is certainly a most curious fact that so few seeds of orchids seem to vegetate. With other wild plants, though the number of mature individuals cannot perhaps be much increased, yet we constantly see great masses of seedlings rising so thickly together that they evidently perish by starving each other out. We never see such masses of young orchids, and it is well known that only one or two of our most experienced cultivators of

these plants have succeeded in raising them from seed. We are almost inclined to suppose that, in spite of all the elaborate machinery employed in effecting their fertilization, after all the greater part of the seeds must be bad.

The Duke of Argyle, in his 'Reign of Law,' says, that if asked whether he believed that every separate species has been a separate creation, not born but separately made, he must answer that he does not believe it. The facts do suggest to the mind the idea of the working of some creative law, almost as certainly as they convince us that we know nothing of its nature, or of the conditions under which it does its glorious work. But law is the servant, not the master of the creator, and requires the constant supervision of a guiding will to produce the effects which we see. The various forms of the organs of reproduction in the Orchid family, which Mr Darwin has so well described, do in fact show the most decided evidence of a creative will.

'Mr Darwin himself cannot avoid being influenced by a consciousness of this, and he

instinctively uses language in accordance with this feeling; he exhausts every form of words and of illustration by which intention or mental purpose can be described,—"contrivance," "curious contrivance," "beautiful contrivance," these are expressions which recur over and over again.'

As to this remark, Mr Darwin, in a subsequent edition of his work on the 'Origin of Species,' merely acknowledges that he had been too careless in the use of his terms.

But Mr Wallace gives us an answer to this view of the action of a Creative will in the formation of these plants, and a very curious answer it is.

'All these extraordinary circumstances attending the fertilization of orchids are not necessary, many other flowers are fertilized without any such machinery, and therefore it is absurd to suppose the Creator purposely producing this particular mode of fertilization just as a human mechanic might produce a toy.' Mr Wallace then, without seeming to be aware that his own views are open to the objection which he has just taken, goes on to

explain the production by natural selection of this unnecessary plan, and takes the case of the Angrœcum sesquipedale, and gives the same description of the manner in which its fertilization is effected as Mr Darwin. Mr Wallace predicts that a species of moth with a very long tongue will be found some day or other in Madagascar, the native country of the Angrœcum.

The reader will note that if the elaborate machinery employed in the fertilization of orchids is not necessary, it cannot have been produced by the survival of the fittest during a course of evolution from some remote ancestor of simple form; clearly the least elaborate machinery which could effect the object would in such a case be naturally selected. If the production of unnecessary forms is an absurdity on the supposition of special creation, it is an impossibility on that of natural selection.

Another case mentioned in the 'Reign of Law,' as not capable of explanation by Mr Darwin's theory, is that of the extreme beauty of the plumage of the humming-birds.* 'Dif-

* 'Reign of Law,' p. 231.

ferent parts of the plumage have been selected in different genera as the principal subject of ornament. In some it is the feathers of the crown worked into different forms of crest; in some, it is the feathers of the throat, forming gorgets and beards of many shapes and hues; in some, it is a special development of neck plumes, elongated into frills and tippets of extraordinary beauty. In a great number of genera the feathers of the tail are the special subjects of decoration, and this on every variety of principle and plan of ornament,' and so on.