flower to the mature stigma in another flower which has opened a little earlier or a little later, and cross fertilisation is thus effected. The vegetable kingdom is full of contrivances for this carrying of pollen, by means of insects, and for rendering self-fertilisation impossible, or at least very difficult. In the Salvia the anther is at one end of a cross-bar lightly affixed across the end of the filament, the other end of the cross-bar being unprovided with an anther. When a bee inserts its proboscis into the flower its head strikes against the end of the cross-bar which has no anther, turns it right over, the end of the filament being the fulcrum, and tips the pollen out of the anther on to the back of the insect, and it is thus carried to another flower.

Fertilisation of Orchids.

A very remarkable series of contrivances for effecting cross-fertilisation has been illustrated, with great patience and ingenuity, by Mr. Darwin, in the case of our native Orchids, both the common meadow species and those which grow especially on the chalk hills of our southern counties. Mr. Darwin found that if one of these Orchids is covered over with muslin gauze so as to prevent the visits of insects it never perfects any seed; indeed, the structure of the flower is such as to render self-fertilisation all but impossible. The pollen does not in these plants exist in separate grains, but is glued together into club-shaped masses called pollinia, placed immediately above the stigma, so that they could hardly, of their own accord, come in contact with it. These pollinia are attached to a viscid disc at the base. The Orchids are chiefly visited by butterflies and moths. When one of these inserts its proboscis into the tube of the flower which contains the honey, its head necessarily strikes against this viscid disc, which it detaches and carries away with the pollinia adhering to it. In Darwin's admirable work on the "Fertilisation of Orchids," a masterpiece of experimental research, which every one interested in the subject ought to read, is a drawing of the head of a moth, which he actually captured, with quite a number of these pollinia adhering to it. After the removal of the pollinia a very curious change takes place in their position in consequence of their exposure to the air. After a few minutes' exposure the viscid substance at the disc sets, or becomes hard, and in so doing changes the direction of the pollinia from vertical to nearly horizontal. The result of this is, that when the moth, with one of these pollinia attached to its proboscis, enters another flower, it must necessarily strike the pollinia against the stigma, and thus detach a sufficient quantity of the pollen of which it is composed to ensure the fertilisation of the ovule. All these processes may be followed by removing the pollinia from the flower of any common Orchid by means of a pin or fine pencil, instead of the proboscis of an insect. In Coryanthes the contrivance is still more remarkable. "The Orchid has part of its labellum or lower lip hollowed out into a great bucket, into which drops of almost pure water continually fall from her secreting horns which stand above it, and when the bucket is half full, the water overflows by a spout on one side. The basal part of the labellum stands over the bucket, and is itself hollowed out into a sort of chamber with two lateral entrances. Within this chamber there are curious fleshy ridges. The most ingenious man, 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 in order 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 through a passage formed by the spout or overflow. Dr. Crüger saw a continual procession of bees thus crawling out of their involuntary bath. The passage is narrow, and is roofed over by a 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 through the passage of a lately-expanded flower, and are thus carried away. 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 first comes into contact with the viscid stigma, and adheres to it, and the flower is fertilised. Now, at last, we see the full use of every part of the flower—of the water-secreting horns, of the bucket half full of water, which prevents the bees from flying away, and forces them to fall out through the spout, and rub against the properly-placed viscid pollen masses and the viscid stigma. The construction of the flower in another closely-allied Orchid, the Catasetum, is widely different, though serving the same end, and is equally curious. Bees visit these flowers, like those of the Coryanthes, in order to gnaw the labellum; in doing this, they inevitably touch a long, tapering, sensitive projection, or, as I have called it, the atenna. This atenna, when touched, transmits a sensation or vibration to a certain membrane, which is instantly ruptured; this sets free a spring, by which the pollen mass is shot forth like an arrow in the right direction, and adheres by its viscid extremity to the back of the bee. The pollen mass of the male plant—for the sexes are separate in this Orchid—is thus carried to the flower of the female plant, where it is brought into contact with the stigma, which is viscid enough to break certain elastic threads, and, retaining the pollen, fertilisation is effected." To illustrate the extraordinary variety in Nature's contrivances, it may be mentioned that one species—the curious Bee Orchis of our chalk hills—offers a remarkably contrast to this ordinary arrangement. This Orchis Darwin has never, after the most diligent research, seen to be visited by insects; and is, must, consequently, be self fertilised. Accordingly, its pollinia are found to be of different structure to those of other members of the family. Instead of standing stiff and upright, they have much longer stalks than is ordinarily the case, which, when mature are flexible, and cause the pollen-masses to hang down in front of the stigma, against which any breadth of wind would cause them to strike, and thus bring about self-fertilisation. It would seem as if different kinds of insects have a partiality for different kinds of flowers, and even for different colours. Plants with very large bell-shaped flowers are fertilised chiefly by large moths belonging to the tribe of sphinxes, and by large beetles of the cockchafer or rose-chafer kind. The largest-flowered of European plants—the Pæony, the Rose, the large white Convolvulus of the hedges, and the Evening Primrose—are fertilised in this way. The Evening Primrose, which opens about sunset, is visited by the largest kinds of night-flying moths, which are attracted from great distances by its delicate scent. The connection thus opened out between the animal and vegetable worlds, and their mutual dependence one on another, is almost infinite. Many plants would appear to depend for their fertilisation on the visits of one particular insect, native to the districts where it grows; and, therefore, if transplanted to another country, or another climate, where this particular insect is not found, although they may flower abundantly, they will not produce fertile seeds. The American Yucca, for instance, which flowers with us, but never bears fruit, has lately been found to owe its fertilisation to a particular species of moth, which has its proboscis extraodinarily modified to obtain the nectar from the flowers of this plant only. Many of the exotic plants grown in our gardens, though thriving and flowering freely, are never known to produce seeds, doubtless from the absence of the insects specially adapted to fertilise them. This is the case with the Yellow Jessamine, so commonly seen flowering in the depth of winter, a native of Japan, and with the Calycanthus, or All-spice tree. There is a species of Orchis with the nectary of prodigious length (11½ inches have been measured in specimens cultivated in this country), called, from this circumstance, Angræcum sesquipedale, which long taxed Mr. Darwin's ingenuity as to the mode by which it could be fertilised, the nectar only occupying 1½ inch of the whole length of the nectary. He predicted, in his "Fertilisation of Orchids," that an insect must exist in its native country (Madagascar) with a proboscis long enough to reach to the bottom of the nectary; and, quite recently, this has been proved to be actually the case.

Insects and Geographical Distribution.

The geographical limits of the natural distribution of many plants are again fixed rather by the distribution of the insects which fertilise them than by the climatic requirements of the plants themselves. Local botanists state that in certain districts of south Lancashire many wild plants are not found, or only very rarely, which are extremely abundant with us in the south of England, such as the Laminum album or White Dead-Nettle, the Convolvulus arvensis or smaller Bindweed, the absence of which can only be accounted for on similar grounds, there being nothing in the climate or soil to prevent their occurrence. Mr. Grindon states that the fragrant Labiates (every Labiate, in fact, that yields powerful odour) are wanting, except Stachys sylvatica, and the wild Thyme in one or two very rare localities. The white Dead Nettle, the Hound's-tongue, the Sweet Violet, the Plantago media, all among the commonest of common plants in the southern countries, are here all but entirely absent. The two common Mallows are very rarely seen, the common Bindweed, never; the Cowslip is extremely local; the Comfrey is unknown, as also is the commonest of the wild Poppies. On the other hand, some splendid plants, like the Giant Bell-flower, Campanula latifolia, hardly known in the south, are here very common. As one travels from a more southern clime northwards, one class after another of insects disappear, and with them the plants which depend on them for fertilisation. In Alpine and Arctic countries a number of the native plants, especially the trees like the Birch and the Fir, have very inconspicuous flowers, and are exclusively wind-fertilised; while others have remarkably brightly-coloured or powerfully-scented flowers, like the Rhododendron or Alpine Rose, and the