these results are true, the vegetable machinery would seem to work at a loss, and with a real, though it be a small, waste of material! When any carbonic acid taken into the leaves passes off unchanged, so much work is not done; but there is no waste or loss in the process of manufacture. But, looking at the food of plants and their products, — comparing the raw material with the manufactured article, — it seems apparent that any carbonic acid which is reduced to carbonic oxide, and given off as such, is so much loss or waste! We may avoid this unwelcome conclusion by the supposition that the carbonic oxide and carburet of hydrogen are products of the decomposition of some of the vegetable matter coëtaneous with vegetable assimilation, but no part of that process itself. This is the more probable, since it cannot reasonably be supposed that carbonic acid supplied to the foliage is resolved into oxygen and carbonic oxide and both set free, — which seems to be the alternative.

REPRODUCTION OF ORCHIDS.

Much curious information in relation to the above subject has been brought out by Mr. Darwin, the well-known English naturalist, in a recently-published work. Of these curious plants, it is stated that 433 genera, including about 6,000 species, are now known; and, as may be readily imagined, the natural provision for their reproduction is strikingly efficient. Of this, Mr. Darwin testifies from his own observation. He says: —

"I was curious to estimate the number of seeds produced by orchids; so I took a ripe capsule of *Cephalanthera grandiflora*, and arranged the seeds as equably as I could in a narrow hillock, on a long ruled line, and then counted the seeds in a length, accurately measured, of one-tenth of an inch. They were 83 in number, and this would give for the whole capsule 6,020 seeds; and for the four capsules borne by the plant 24,000 seeds. Estimating in the same manner the smaller seeds in *Orchis maculata*, I found the number nearly the same, viz., 6,200; and, as I have often seen above 30 capsules on the same plant, the total amount will be 186,300, — a prodigious number for one small plant to bear. As this orchid is perennial, and cannot in most places be increasing in number, one seed alone of this large number, once in every few years, produces a mature plant. I examined many seeds of the Cephalanthera, and very few seemed bad. To give an idea what the above figures really mean, I will briefly show the possible rate of increase of *O. maculata*. An acre of land would hold 174,240 plants, each having a space of six inches square, which is rather closer than they could flourish together; so that, allowing 12,000 bad seeds, an acre would be thickly clothed by the progeny of a single plant. At the same rate of increase, the grandchildren would cover a space slightly exceeding the island of Anglesea; and the great-grandchildren of a single plant would nearly (in the proportion of 47 to 50) clothe with one uniform green carpet the entire surface of the land throughout the globe!"

Mr. Darwin has also ascertained that self-fertilization is a very rare event with orchids, and that most species, through a curious provision of nature, absolutely require the aid of insects for their reproduction.

This is obvious from such an arrangement of the organs that the pollen-mass (pollinium) and other connected parts are too closely embedded to be shaken out by violence. Somehow, the precious pollen must be transferred; the little grains, so reproductive when properly applied, would be useless in their original position. They are there with all their natural fertilizing qualities, but they must be elsewhere before these can be serviceable. What is to transport them if they cannot be shaken out by a gentle violence? Try Mr. Darwin's experiment, and you will arrive at his conclusion. He covered one plant under a bell-glass before any of its pollinia had been removed, and he left three adjoining plants uncovered. Frequent examinations disclosed the fact that some of the pollinia were daily removed from the uncovered plants until nearly all were gone, while all the pollinia remained firm in the cells of the glass-covered plant. Other observations tend to a like result. From all of them it may be inferred that there probably is a proper season for each kind of orchis, and that insects cease from their visits to it after the proper season has passed, and the regular secretion of nectar has ceased.

The evidence of insect visitation is not derived from their detection in the flowers; and it is a curious circumstance that, although Mr. Darwin has been in the habit for twenty years of watching orchids, he has never seen an insect actually visit a flower, excepting, indeed, some butterflies on two occasions. We are to look for the evidence of their visitations, not by attempting to detect the insects in the act, but by discovering the stolen goods, the pollinia, upon their bodies. This Mr. Darwin has especially observed in the case of moths, who are attracted, with other insects, by the peculiarly sweet nectar secreted by the orchis flowers.

The nectar-secreting apparatus in some species is very curious. In one species, the *Coryanthis*, two little horns near the straplike junction of the labellum with the base of the column secrete so much limpid nectar, having a slightly sweet taste, that it slowly distils, and a single flower will in all secrete about an ounce weight. The most remarkable appendage is that of the deeply-hollowed end of the labellum, which hangs some way down, exactly beneath the two little horns, and catches the drops as they fall, precisely like a bucket suspended some way beneath a dripping spring.

In fact the arrangement for seducing the insects to visit and alight upon the flowers is in some cases so ingenious that Mr. Darwin, in describing it, exclaims: "A poet might imagine that whilst the pollinia are borne from flower to flower, adhering to a moth's body, they voluntarily and eagerly place themselves, in each case, in that exact position in which alone they can hope to gain their wish and perpetuate their race."

The special adaptation of parts for the fertilization of *Listera ovata* is clearly unfolded, and worth attentive study:—"The anther-cells open early, leaving the pollen-masses quite loose, with their tips resting on the concave crest of the rostellum. The rostellum then slowly curves over the stigmatic surface, so that its explosive crest stands at a little distance from the anther; and this is very necessary, otherwise the anther would be caught by the viscid matter, and the pollen forever locked up. This curvature of the rostellum over the stigma

and base of the labellum is excellently well adapted to favor an insect striking the crest when it raises its head, after having crawled up the labellum, and licked up the last drop of nectar at its base. The crest of the rostellum is so exquisitely sensitive that a touch from a most minute insect causes it to rupture at two points, and instantaneously two drops of viscid liquid are expelled, which coalesce. This viscid fluid sets hard in so wonderfully rapid a manner that it rarely fails to cement the tips of the pollinia, nicely laid on the crest of the rostellum, to the insect's forehead. The pollen-masses, when once cemented to an insect's forehead, will generally remain firmly attached to it until the viscid stigma of a mature flower removes these encumbrances from the insect, by rupturing the weak elastic threads by which the grains are tied together, receiving at the same time th benefit of fertilization."

Mr. Darwin also describes the curiously constructed arrangements for reproduction existing in the *male* flowers of another variety of orchids, viz., the *Catasetum*. It is necessary that the pollen-masses of these flowers be transported to female plants in order that seed may be produced. Now, in these male flowers, the pollinium is furnished with a viscid disc of huge size; but the disc, instead of being placed, as in other orchids, in a position likely to touch and adhere to an insect visiting the flower, is turned upwards and lies close to the upper and back surface of a chamber, which must be called the stigmatic chamber, though functionless as a stigma. There is nothing in this chamber to attract insects; and even if they did enter it, it is hardly possible that the disc should adhere to them, for its viscid surface lies in contact with the roof of the chamber. How then does nature act? She has endowed these plants with what must be called, for want of a better term, sensitiveness, and with the remarkable power of forcibly ejecting their pollinia to a distance. Hence, when certain definite points of the flower are touched by an insect, the pollinia are shot out like an arrow which is not barbed, but has a blunt and excessively adhesive point. The insect, disturbed by so sharp a blow, or after having eaten its fill, flies sooner or later to a female plant, and, whilst standing in the same position as it did when struck, the pollen-bearing end of the arrow is inserted into the stigmatic cavity, and a mass of pollen is left on its viscid surface. Thus, and thus alone, species of the genus Catasetum are fertilized."

Notwithstanding the immense seed-produce of orchids, the greatest care is taken throughout this vast order, with its more than four hundred genera and its six thousand species, that the pollen shall not be wasted; and yet, so far as all observation goes, the act of fertilization is for the most part left to insects. In commenting on this curious circumstance, Mr. Darwin uses the following language: — "Considering how precious the pollen of orchids evidently is, and what care has been bestowed on its organization and on the accessory parts, — considering that the anther always stands close behind or above the stigma, self-fertilization would have been an incomparably safer process than the transportal of the pollen from flower to flower. It is an astonishing fact that self-fertilization should not have been an habitual occurrence. It apparently demonstrates to us that there must be something injurious in the process. Nature thus tells us, in the

most emphatic manner, that she abhors perpetual self-fertilization. This conclusion seems to be of high importance; and may we not further infer as probable, in accordance with the belief of the vast majority of the breeders of our domestic productions, that marriage between near relations is likewise in some way injurious, — that some unknown great good is derived from the union of individuals which have been kept distinct for many generations?"

THE UGLIEST PLANT IN EXISTENCE.

At a recent meeting of the Linnæan Society, London, Dr. J. D. Hooker described a new plant, which he characterized as not only structurally the most peculiar, but it is probably the ugliest plant that has ever been seen. It was discovered by Dr. Welwitsch beyond the northern limits of Cape Town, Southern Africa, and has received the name of *Welwitschia mirabilis*. It is a stunted-looking kind of tree, whose summit never reaches more than two feet above the level of the ground, whilst its short woody trunk never possesses more than two leaves. These extraordinary leaves are, in point of fact, the expanded seed-lobes, or cotyledons, which make their appearance as soon as the young plant rises out of the ground; and, what is still more astonishing, these aforesaid leaves live, grow, and remain attached to the stumpy trunk during the entire life of the tree, which, it is calculated, lives at least one hundred years. We may also further observe that these two persistent foliar organs spread out laterally, in some fine examples of the *Welwitschia* attaining, each of them, a length of nearly six feet. The flowering axes shoot up from the summit of the stumpy trunk, which is flattened at the top, and like a folded card-table is divided by a central line into two equal halves. The root is conical, and longer than that part of the trunk which appears above ground. There are many other points of peculiar scientific interest connected with the form and structure of this astonishing plant.