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MIMICRY IN PLANTS.

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[PLATE LXXIX.]

THE subject of so-called "Mimicry" in the animal kingdom has recently attracted no small share of attention both from naturalists and from amateurs. The phenomena included in the term are indeed such as, from their singularity and their apparent marvellousness, cannot but captivate even the most *dilettante* student of Nature. Mr. Bates, in his "Naturalist on the Amazons," may be said to have first introduced the subject to the notice of the general public. Mr. Trimen has recorded, in the "Transactions of the Linnean Society," some remarkable and beautiful instances among South African Lepidoptera; and Mr Wallace, in his delightful "Malay Archipelago," has done still more to arouse the interest of even the most unobservant reader. Some of the imitations depicted in the illustrations of the latter book are, indeed, simply wonderful. The object of this singular mimicry is considered, by those most conversant with the subject, to be a certain amount of protection gained by the "mimicking" species, through its superficial resemblance, thus acquired, to another species, which enjoys, for some reason, special immunity from the attacks of enemies, or to some inanimate object. Whether this explanation is supported by a careful examination of the facts it is not now my purpose to inquire, the subject having been ably debated elsewhere. This resemblance occurs sometimes between species belonging to one family or order, as between one butterfly and another; sometimes between forms much more distantly related, as between a fly and a bee, or an ant and a spider; sometimes between animals and inorganic objects, as between a caterpillar and a twig, or an insect in the perfect condition and a decayed

leaf. The superficial resemblance is occasionally so close, and carried into such marvellously minute details of structure, that even the eyes of practised entomologists are deceived, as it is supposed those of the natural enemies of the animal are.

Two explanations, and two only, have been offered of the origin of this "mimetism," or "protective resemblance":—natural selection and hybridisation. Mr. Darwin, Mr. Wallace, and Mr. Bates advocate the former view, maintaining that the resemblance is brought about by exceedingly slow gradations, each small variation in the direction of the species ultimately mimicked being perpetuated to the prejudice of the offspring which do not thus vary, by the operation of the law of "The Survival of the Fittest." This theory commends itself, on its first enunciation, from its beauty and simplicity, and has been eagerly adopted and zealously defended by the ultra-Darwinians who form the bulk of our rising naturalists. That this explanation is, however, not so free from difficulty as its advocates have imagined, has been shown by several recent writers, and especially by Mr. Mivart in his very able "Genesis of Species," although he has not offered any definite counter-hypothesis. The theory of hybridisation has found an advocate in one able and experienced naturalist, Mr. Andrew Murray, but has not met with general acceptance, and, in addition to other objections, is obviously inapplicable, at all events, to the cases of the imitation by animals of inorganic forms.

That similar curious resemblances have not hitherto been described in the vegetable kingdom, is mainly because they have not been looked for with the same zeal; and no doubt also arises partly from the much greater difficulty of preserving the outward appearance of plants than of animals. The exterior covering of most animals, and in the case of insects the whole of the body, is comparatively easily preserved, without loss of colour or form, in museums or cabinets. We have no such method of preserving the tenderer parts of plants; and, with respect to the colour and form of the natives of tropical or unexplored regions, have to trust greatly to the very unreliable fidelity of artists, very few of whom have any accurate scientific knowledge. Since, therefore, the most remarkable developments of both animal and plant life occur in the wild luxuriance of tropical countries, it is only the few who have had the good fortune to travel in those regions who have much practical opportunity of studying the phenomena we are discussing, except in the case of the few species that have been cultivated in Europe. The only work that has come under my notice in which the subject is discussed, is a little book published in 1869, by Mr. L. H. Grindon, entitled "Echoes in Plant and Flower Life," and he has avowedly not treated it in

a scientific manner, but has collected together a large number of curious and interesting facts for others to draw their conclusions from. At the last meeting of the British Association at Edinburgh, Professor Thistleton-Dyer read a short paper with this title, but it is very far from exhausting the subject. The visitors to the *soirées* of the Linnean Society for the last two years have also been attracted by the collections exhibited by that munificent patron of horticulture, Mr. W. Wilson Saunders, of so-called "mimetic plants," consisting of pairs of species resembling one another in their foliage or habit to so extraordinary a degree—and yet belonging to entirely different natural orders—that even a good botanist might well be excused for passing them over as identical.*

Before alluding to the theories which have been broached on the subject, let us examine the facts which may be collected, and attempt to classify them. The resemblances among plants sufficiently close to deserve the appellation of mimicry may be classed under two heads:—those which relate to the whole habit and mode of growth, and those which refer to the development of some particular organ or part.

Taking first the former of these classes: there are a number of facts which are familiar to every student of botany, and even to casual observers. Every one knows that to a certain extent that assemblage of characters which we call the habit of a plant becomes changed by the circumstances in which it grows. A tree in a warm genial climate becomes a dwarf shrub when exposed to the bitter cutting winds of northern latitudes; an annual in a temperate changeable climate becomes a perennial when transplanted to a tropical country where there is no alternation of summer and winter. Hence the general features which characterise what have been termed the phyto-geographical regions of the earth; the absence of trees, and the prostrate shrubs with a peculiar tortuous and compact habit of growth of the Arctic zone; the green pastures, showy flowering annual herbs, and deciduous forests of temperate latitudes; the shiny-leaved evergreen forests and profusion of splendid climbers of the tropics; and the scanty thorny or succulent vegetation of the deserts. Under peculiar conditions all plants, no matter to what class they belong, or how remote their relationship, have a tendency to assume a certain resemblance in external features. Plants growing in running water, whether flowering or flowerless, *Ranunculus* or *Myriophyllum*, *Chara* or *Potamogeton*, have the submerged leaves long and filiform,

* To the courtesy of Mr. Saunders and of his very intelligent gardener Mr. Green, who has paid special attention to this subject, we are indebted for the facility for making several of the drawings with which this paper is illustrated.

or cut into slender divisions. Maritime plants growing within reach of the salt spray are apt to become dwarf and fleshy in their habit; and the same remark applies to those which grow on exposed mountain summits, where they are liable to severe though short droughts during the brief but intense summer. In arid desert situations this feature of the vegetation is still more remarkable. Our yellow and white stone-crops, with their round juicy leaves, lovers of rocks and dry walls, are replaced, as we go farther south, by larger species of the same order, or by the similarly disposed Ficoideæ, as the pretty little *Mesembryanthemum crystallinum*, the ice-plant of our greenhouses, which refreshes with its cool foliage the borders of the desert in Egypt, and elsewhere in North Africa. Many orders of plants, indeed, occurring with us only as ordinary herbs or slender shrubs, are represented in those countries by genera of succulent plants, great favourites in our greenhouses, whose affinity it is hard to recognise.

One of the most remarkable features of the hotter and drier parts of America is the abundance of different forms of Cactus, so much cultivated in this country for the beauty of their flowers and the singular weird form of their trunks, which perform the functions of both stem and leaves. Having its head-quarters in Mexico, the order extends as far as the temperate latitudes of Chile and Canada, and includes, on a moderate computation, at least one thousand species. In Africa the order is entirely absent, or rather its absence is made more conspicuous by the occurrence of a single species of *Rhipsalis* at the Cape; but its place is supplied by another class of plants, the *Euphorbias*, a genus represented in this country by several inconspicuous but familiar weeds known as Spurges. In tropical and subtropical Africa the genus assumes the habit and general appearance of the absent *Cacti*, though in their botanical affinities they are nearly as remote as two orders of plants can well be. Except when they are in flower, it is, indeed, difficult to believe that these African *Euphorbias* are not in reality *Cacti*; and the resemblance is not merely a general one; particular groups, and even species, of African *Euphorbia* imitate particular groups or species of American *Cactus* in the form and habit of the stem and the arrangement of the spines, so that it is almost impossible to distinguish between them. This singular imitation is not, moreover, confined to these two families. The accompanying illustration (Fig. 1), reminding one irresistibly of a familiar *Cactus*, is drawn from a species of *Stapelia*, allied to *S. hirsuta*, belonging to the order Asclepiadaceæ, a near ally of the brilliant and fragrant *Stephanotis* and *Hoya* of our stoves, and equally remote, in any system of classification, alike from the Cactaceæ and the

Euphorbiaceæ. Additional instances of close general resemblance in habits of plants destitute of the slightest structural affinity are afforded by *Haworthia*, a genus of Liliaceous, and *Echeveria*, a genus of Crassulaceous plants, the former allied to the lilies and aloes, the latter to the stone-crops; and by Figs. 2 and 3 in our illustration, representing a Cactaceous (*Rhipsalis funalis*) and a Euphorbiaceous plant (*Euphorbia Tirucalli*), the one from tropical America, the other from South Africa. Multitudes of others might have been adduced equally striking.

If we now pass from general to special resemblances, we find ourselves entering on a still more extensive field. Granting the Darwinian or Lamarckian theory of the descent of allied forms from a common ancestor, and their gradual differentiation from one another, a wider margin of separation, as far as mere external and less important characters are concerned, appears to be allowed to near relatives in the case of plants than of animals. The same genus of plants includes frequently species much more widely divergent in habit and in all superficial features than ever occurs among animals. Hence far more play is given to a species to simulate the appearance of another species of some very remote genus, as is often indicated in the specific names of plants: *Polygonum Convolvulus*, *Solanum jasminioides*, *Osmanthus ilicifolius*, &c. To such a height in even minute details is this resemblance often carried, that the most experienced botanist has sometimes referred a plant, on a too cursory examination, to a genus or even natural order with which it has no affinity whatever. Thus Sir William Hooker is said to have actually figured a *Veronica* as a Conifer; Kunze, a great authority on ferns, considered the curious *Stangeria paradoxa*, a Cycad, allied to the Conifers, as a true fern; and Dr. Berthold Seemann speaks of having, in the Sandwich Islands, met with a variety of *Solanum Nelsoni*, "which looked for all the world like *Thomasia solanacea* of New Holland, a well-known Buettnereaceous plant of our gardens, the resemblance between these two widely-separated plants being quite as striking as that pointed out in Bates's 'Naturalist on the Amazons' between a certain moth and a humming-bird." *

Less striking instances than this are familiar to all who have made plants their study. The pseudo-papilionaceous flowers of the Cape species of *Polygala* have deceived many a young botanist. The flowers of *Mesembryanthemum* remind one irresistibly of the compound capitula of Compositæ. The remarkably fern-like foliage, extending even to the dichotomously-forked venation, of the hardy Conifer *Salisburia adiantifolia*, is well known to all arboriculturists. The so-called *Fungus melitensis* of Malta is in reality a flowering plant belonging to

* "Gardener's Chronicle," June 27, 1868.

the order Balanophoreæ. The resemblance between the true leaves of the *Eucalypti*, or gum-trees, and the dilated petioles or phyllodia of the *Mimosæ*, both presenting their edges instead of their surfaces to the sky and earth, and both abundant forms of trees in Australia, is very remarkable. The development of ascidia or pitchers from the leaf-stalk or leaf itself occurs not only in the American *Sarracenia* and *Darlingtonia* and the Asiatic *Nepenthes*, belonging to orders at almost the opposite poles of flowering plants, but in Rosaceæ, Asclepiadaceæ, and several other natural orders. The singular irritability of the leaves of the *Mimosa pudica*, or sensitive plant, and other species of Leguminosæ, occurs again in another order of very little structural affinity, but presenting curious analogies in its foliage, the Oxalideæ, or wood-sorrel order. Dr. Hooker describes and draws, in his "Flora Antarctica," a most singular species of *Caltha* (allied structurally to our marsh-marigold), whose leaves are almost an exact reproduction of those of the *Dionœa muscipula*, or "Venus's fly-trap." In the collection of Mr. Saunders is a species of olive, *Olea ilicifolia*, and a variety of the common holly, *Ilex aquifolium, var. macrocarpum*, in which the resemblance is extraordinarily close, not only in the shape of the leaf and of the spiny teeth, but in the very arrangement of the principal veins, and even in the texture and colour. Pairs of leaves exhibiting as close resemblance may be composed of an *Anemone* (Ranunculaceæ) and a *Pelargonium* (Geraniaceæ), a *Gnaphalium* (Compositæ) and a *Lavandula* (Labiatæ), an *Oxalis* (Oxalideæ) and a *Crotalaria* (Leguminosæ), a *Gentiana* (Gentianaceæ) and a *Veratrum* (Melanthaceæ), a *Grevillea* (Proteaceæ) and an *Acacia* (Leguminosæ), a carrot (Umbelliferæ) and a *Pelargonium* (Geraniaceæ), and of a *Thujopsis* (Coniferæ) and a *Selaginella* (Lycopodiaceæ); the last pair comprising a flowering and a cryptogamic plant.*

Nor are we confined to the leaf for the recurrence of the same type in widely separated families. The peculiar mode of dehiscence of the anther to allow of the escape of the pollen known as "opening by recurved valves" occurs in the Berberidaceæ, in the Lauraceæ, and in a single tribe of Combretaceæ. The pollen grains covered with spiny prominences are found in Malvaceæ and in some Compositæ. But far more curious and striking than these is a remarkable recurrence in several orders of an almost identical external appearance of the fruit. Any indehiscent fruit with a broad membranous wing is called by botanists a "samara," of which we have instances, among our own forest-trees, in the elm, the sycamore, the maple, and the "keys" of the ash. Figs. 4—7 represent the form assumed

* See complete lists in "Nature," May 26, 1870, and May 4, 1871.

by the samara in four genera, belonging to three distinct natural orders, all large shrubs or trees, natives of Brazil. A single genus of Polygalaceæ, the *Securidaca*, chiefly inhabitants of Tropical South America, but extending also into Africa and India, is distinguished by its remarkable winged fruit, varying somewhat in different species, one of the commonest of which is represented by Fig. 4. In Figs. 5 and 6 are delineated the similar samaroid fruits of two species belonging to different genera of the order Phytolaccaceæ, and having therefore no genetic affinity whatever with the first. Fig. 7 again is an example of the fruit of a *Heteropterys*, a genus of Malpighiaceæ, comprising a large number of species, also mostly Tropical American, with a few representatives in Africa. This order is again equally dissociated from both the preceding ones. It will be remarked that not only the form of the wing, but its very texture and the arrangement of the veins, are reproduced most accurately in all the species, a dissection of the fruit alone showing their essential difference in structure. So close indeed and deceptive is this resemblance when the plant is not in flower, that the very specimen of the *Seguiera* from which our drawing is taken, in the Berlin Herbarium, is labelled by so experienced a botanist as Klotzsch as *Securidaca*; and Walpers, in his "Repertorium," has erroneously described five species of *Seguiera* as *Securidacas*. Everyone, indeed, familiar with herbaria, will know of similar instances. It should be noted also that the samaroid fruit is not characteristic of any one of these three natural orders, but only of certain tribes or of single genera. When attention is directed to the subject, a careful search would doubtless be rewarded by the detection of a large number of instances of similar resemblance or mimetic analogy in the vegetable kingdom, as remarkable, or even more so, than those we have here instanced.

Having now chronicled a few of the facts of this curious and interesting subject, I shall be expected at least to attempt some explanation, or to start some theory respecting them. And here our real difficulty commences. Even to arrive at the recognition of any one law running through these phenomena seems, in the present state of our knowledge, impossible. In the first place I shall be found fault with for using the term "Mimicry" in reference to the subject at all. But I must confess to being unable to see the force of the objection, and must continue to consider the series of facts as observed in the animal and vegetable kingdoms as essentially parallel. Strictly speaking, on etymological grounds, the term is open to some objection; *μίμησις*, "an imitation; a representation by art," implies doubtless a conscious intentional mimicry, which we can no more believe in, in the case of butterflies, than of

flowers; or at all events this hypothesis is entirely inconsistent with the theory of development by Natural Selection only. There is doubtless an apparent object in the one case which we are unable to detect in the other; but this does not seem to me sufficient reason for giving a different name to the phenomenon itself.

Professor Thistleton-Dyer objects to the application of the term "Mimicry" to the case of closely resembling plants, on the ground that we do not here find the imitative species occupying the same area as occurs in the animal kingdom. The instances I have given above will show, however, that his statement that "the resembling plants are hardly ever found with those they resemble" is a far too general one. Professor Dyer has made a useful suggestion in proposing the terms "homoplastic" and "Homoplasy" (first applied by Mr. E. R. Lankester to external resemblances in the organs of animals) to the class of phenomena under discussion. The term is a good one, as simply expressing a fact and not a theory, and is free from the objection I have mentioned above to the use of "Mimicry."

One explanation of Mimicry or Homoplasy in plants that has been suggested is that it is due to consanguinity or heredity; and a writer in "Nature" has even been bold enough to offer this suggestion to account for the resemblance between a *Thujopsis* and a *Selaginella* already referred to. But the value of the theory of hereditary reversion is entirely destroyed if it is strained in this manner. It is true that some botanists have traced a genealogical affinity between Conifers and the higher Cryptogams; but the relationship is at the best a very remote one; and to attribute the external facies of a Conifer to its alliance with a Lycopodium is as wild as to attempt to account for the varied colours of birds by their affinity to insects, or of snakes from their alliance with fishes. To be consistent, this theory ought to be applied to the animal kingdom also, and is a hundred times more to the purpose as an explanation of mimetism among Lepidoptera. We may compare with this unnatural straining of a theory the truly scientific manner in which Mr. Darwin applies the principle of heredity to account for the occasional occurrence of stripes on the hind-quarters of the horse from its affinity with the zebra. If, however, hereditary reversion acts as remotely as has been suggested, this no more proves the horse to be related to the zebra than to the hyæna.

A certain class of general superficial resemblances may undoubtedly be attributed to the action of natural external causes, to a similarity of conditions of growth; and to these I have already sufficiently alluded. This explanation is, however, entirely inadequate in the case of the minute resemblances

of species to species, either in the general habit, or in the development of some particular organ, the leaf or the fruit, such as I have attempted to describe and to represent in the illustrations. No conjunction of external circumstances will avail to account for these, whether acting through Natural Selection or any other known process.

The theory of Protective Resemblance, so seductive an explanation of similar phenomena in the animal kingdom, is also entirely inapplicable here; it is, in fact, more completely inadequate than either of the others. The only manner in which it seems possible to conceive that a species of the vegetable kingdom can benefit by resembling another species, is by presenting so close an imitation of its flowers, in appearance or odour, that it may thereby deceive insects that would otherwise pass it by into visiting it, and thus bringing about the necessary distribution of the pollen. But if such mimicry, where there is no genetic affinity, ever occurs in the flower, it is extremely rare. The only instance of such apparent imitation that occurs to me is in the case of the Bee Orchis, and perhaps one or two of its allies; and here the mimicry is not of another flower, but of the insect itself. It might well be assumed that the extraordinary resemblance of the flower of this singular plant to the body of a bee was designed to attract these insects to the flower; but, unhappily for this theory, the Bee Orchis appears to be one of the comparatively small number of plants that are independent of insect agency for the maturing of their seeds. Mr. Darwin, who has closely watched the plant, has never seen a bee or other insect alight upon its labellum; and both he and other observers state that the construction of the pollinia seems especially contrived to secure self-fertilization, in contrast to the provisions of the larger number of species belonging to the order. The special specific resemblances, on the other hand, which I have described, are chiefly in the foliage, the fruit, and the general habit, from which it is difficult to conceive any profit to arise to the species. In many cases also the resemblance occurs between plants which are natives of countries belonging to entirely different phyto-geographical regions, which can never have come into contact with one another. It is just possible that we have a curious instance of protective, or rather of beneficial resemblance in scent, in the case of the carrion-like odour of the flowers of *Stapelia*, which attracts blue-bottle and other flies that may assist in the distribution of the pollen.

We seem then, in attempting to discover some explanation of these phenomena, to be forced back to a view of the operations of Nature which has been too much lost sight of by modern naturalists. Darwin and Wallace's theory of Natural

Selection undoubtedly expresses a great truth, that a struggle for existence is always going on among the far too numerous offspring of the same parents; and that, where no other causes come into operation, those of the offspring which possess any advantageous differences from the remainder will survive to the prejudice of the rest, and will have a tendency to perpetuate this divergence. When, however, Natural Selection is brought forward as adequate to account for the whole history of biological evolution, it presupposes the principle that no change can take place in the way of the evolution of one species from another that is not directly and immediately to the benefit of that individual species;—in other words, that each form of life exists for its own advantage only. But do we not see around us many facts which appear to negative this hypothesis? Biological forms have been evolved presenting peculiarities of structure, special developments of particular organs, not possessed by their parents, but which, as far as we have any means of judging, are and can be of no special advantage to them in the struggle for life. We seem, indeed, more and more compelled to the conclusion that we know next to nothing of the laws which govern the evolution of species, and the development of the marvellously diverse forms of animal and vegetable life that surround us. I cannot myself get away from the conclusion that we must attribute the tendency to variation which is admitted to be the material on which Natural Selection works, to some inherent force belonging of necessity to the functions of life, whether animal or vegetable, which is independent of, and in some sense superior to, the forces that govern the inorganic world. Above all, we are compelled to recur to the pre-Darwinian doctrine of Design; and to believe that Nature has some general purpose in the different modes in which life is manifested, a purpose not in all cases for the immediate advantage of the individual species, but in furtherance of some design of general harmony which it may take centuries of unwearied observation and laborious toil before we discover the key by which we may be able to unlock it.

EXPLANATION OF PLATE LXXIX.

Fig. 1. Stapelia sp. (Asclepiadaceæ).
„ 2. Rhipsalis funalis (Cactaceæ).
„ 3. Euphorbia Tirucalli (Euphorbiaceæ).
„ 4. Fruit of Securidaca lanceolata (Polygalaceæ).
„ 5. „ „ Seguiera floribunda (Phytolaccaceæ).
„ 6. „ „ Gallesia gorazema (Phytolaccaceæ).
„ 7. „ „ Heteropterys argyrophæa (Malpighiaceæ).