In Nature's Workshop.

III.—PLANTS THAT GO TO SLEEP.

By Grant Allen.

PLANTS sleep almost as truly as animals. To be sure, their sleep is a trifle less obtrusive—plants never snore: but it is quite real for all that, and its reality can be shown, as I hope to show it here, in a great many instances. Perhaps the best-marked form of slumber in the vegetable world is that of the great winter rest, when so many species retire altogether under the sheltering soil, and there lie dormant, side by side with the slumbering animals. We all know that when winter approaches the sleek dormouse retreats into his snug nook, a woven nest of warm grasses just above the ground, where he dozes away the cold weather in a state of unconsciousness. Squirrels similarly hibernate in the holes of tree-trunks; while bears grow fat in autumn, and after sleeping the winter through, emerge in April mere wasted shadows of their October selves. As to the cold-blooded animals, such as newts and lizards, snakes and adders, they dream away the chilly months, like the Seven Sleepers of Ephesus, coiled up in tangles among the banks and hedges. The lesser creatures—snails, and beetles, and grubs, and so forth—hibernate underground or conceal themselves in the crannies of rocks and walls. But how does this long winter rest of animals differ, after all, from the winter rest of the crocus or the hyacinth, which withdraw all the living material from their leaves in autumn, and bury themselves inches deep in the soil in the shape of a bulb, till February rains or April suns tempt leaves and flowers out again? The whole vast class of bulbous and tuberous plants, indeed—the lilies, orchids, daffodils, narcissi, tulips, squills, blue-bells, and snow-drops—are they not just hibernating creatures, which retire underground in autumn with the slugs and the queen wasps, to reappear in spring about the same time with the return to upper air of the moles, the tortoises, and the fritillary butterflies?

In the case of pond plants and pond animals, in particular, this close similarity of habit is especially evident. I have pointed out in this magazine already how the frogs and newts betake themselves to the depths before the surface freezes over; and how at the same time, when the whirligig beetles and the tapering pond-snails go below to hibernate, the buds of the frogbit and the growing shoots of the curled pondweed similarly detach their ends from the dying stems so as to bury themselves safely in the unfrozen mud of the oozy bottom. But it may not strike everyone that much the same sort of winter sleep, for plants as for animals, is common on land too. When the squirrel retires into winter quarters in the trunk of the oak, where he has stored up his hoard of acorns against the dead season, does not the life of the oak itself do just the same thing? Does not the tree, too, fall asleep till the succeeding summer? I say "the life of the oak" in the most literal sense: for, remember, the protoplasm or living matter in the green leaves is withdrawn, before they fall, into the vital layer just below the bark; and there it sleeps away the winter, protected by its overcoat of cork-like material from the fierce frosts that would otherwise kill it. Indeed, it is only the dead skeleton of the leaf that drops on the ground: the life remains and hides in the trunk or branches. The withered leaf is like the sloughed skin of the snake, the cast shell of the lobster, the empty pupa-case of the butterfly. Nay, more, one may say roughly that almost all trees and shrubs or perennial herbs hibernate—become dormant in winter: but some of them conceal their living protoplasm in bulbs or tubers which they bury underground, while others store it in the stem or trunk, wrapped warmly up in a thick vegetable blanket.

Even evergreens sleep, though not quite so openly. Take two familiar contrasted cases. The Scotch fir and the larch are closely related: but the larch, a native of wind-swept heights in central Europe and northern

Asia, would have its slender branches broken and its swaying trunk snapped by the weight of snow which they would be compelled to sustain if the leaves persisted on the tree through the winter, besides running a good chance of being blown down in every big storm; so it has acquired the habit (very unusual among conifers) of shedding its cast-off leaves in autumn like the oak and the elm, after it has hidden away their vital contents in the living layer. In this way, it comparatively escapes the heavy load of snow it must otherwise bear, and also presents a far smaller expanse of resisting surface to the wintry Tyrolese and Siberian tempests. The Scotch fir, on the other hand, a stouter tree with stronger branches, can endure the heavy load of snow, which it shifts often enough as the wind strikes it; so it has evergreen leaves, like most of its class: but these needle-like leaves are thick-skinned and covered with a protective glassy glaze which effectually guards the living matter within from the frosts of January. Large-leaved evergreens, like the common laurel and the rhododendron, have a similar glassy layer to protect their foliage: but they are more southern types; our northern winter tries them often, and in severe seasons they get terribly frost-bitten. Even these evergreens themselves thus sleep, though unobtrusively: that is to say, their life is really suspended more or less during the winter months, though the living material is then exposed in the leaves, instead of being withdrawn into the bark as in the larch, or into a bulb or tuber as in the tulip and the crocus.

1.—BRANCH OF MIMOSA, THE LEAF AWAKE.

But besides this yearly winter sleep or hibernation a great many plants also sleep every night: in other words, they suspend more or less their usual activities, and devote themselves to rest and recuperation. For what do we mean by sleep? Well, Mr. Herbert Spencer has admirably defined it as "the period when repair predominates over waste." During our waking times, we walk, work, waste—use up the living material of the body: in our sleeping hours, we rebuild and restore it. Now this is not quite true to the same extent of plants: though even plants in certain senses grow more by night than by day. Yet it *is* true in the main that plants suspend in their sleeping hours a great many functions which they carry on while they wake: and that the sleeping time is mostly devoted to repair and growth, not to active intercourse with external nature. By day, plants eat: by night, they utilize and arrange what they have eaten.

My illustration No. 1 shows the leaf of a mimosa bush in its waking moments. You would call it at first sight rather a branch than a leaf, no doubt; but in that you would be mistaken: it is really one much-divided leaf, though not by any means a simple one: and when it falls off, it falls off from the base like a single structure. It is, in point of fact, a very compound leaf, split up into four main parts, each of which is again subdivided into many opposite pairs of leaflets. Now, in No. 1 here, the leaf is seen as it looks when expanded in the broad daylight: it is hard at work eating and drinking for the benefit of the plant: it absorbs, by all its hundred little mouths or leaflets, the carbonic acid of the surrounding air, which it converts, under the influence of sunlight, into suitable plant-food. It thus *works* in the daylight just as truly as the busy bee works when it gathers honey: just as truly as the ant works when it collects dead meat and scraps of ant-provender: just as truly as the kingfisher works when it darts down upon the trout, or as the fly-catcher works when it swoops upon the flies that flit about in the garden. All these are diurnal plants and animals; they utilize, as Dr. Watts succinctly puts it, "each shining hour": and they rest when night comes from their daily labours. For remember, a plant can only eat its proper food, carbonic acid,

while the light falls upon it; at night it must sleep, digest, and distribute what it has eaten.

No. 2 shows us a larger branch of the same mimosa bush, with two such compound leaves, seen as they look when folded up in sleep during the dark hours of the evening. Not only the famous and well-known Sensitive Plant sleeps like this, but also many other kinds of mimosa and acacia much cultivated in our greenhouses. It is a pretty sight to see them falling gradually asleep — dozing off, if I may be allowed that familiar expression. First of all the opposite pairs of leaflets fold together upward, so as to present a single combined surface, like that of a hinged tablet when you shut its halves together. Then the four main leaf-stalks on which the leaflets are fixed sink slowly down like a sleepy child, and double themselves away out of the range of danger. Last of all, the principal leaf-stalk or main mid-rib of the whole branch-like leaf itself droops and drops drowsily, and the entire structure hangs limp, as if dead, against the branch that supports it. In No. 2 you can see a pair of such four-branched leaves sound asleep in their pendent attitude. Each of these, when expanded, would resemble the open and active leaf in No. 1. You can see for yourself that the waking leaf is obviously equipped for work and action, while the sleeping leaves are quite as obviously arranged for rest and recuperation. You can also observe in No. 2 the main leaf-stalk or mid-rib of a third leaf, which is hanging down unseen, out of the field of the drawing.

2.—BRANCH OF MIMOSA, THE LEAVES FAST ASLEEP.

The machinery for producing these curious sleep-movements is situated in certain very irritable little knobs at the base of the leaf-stalk, one of which you can observe close to the stem in the case of the lowest leaf-stalk (with its leaf unseen) in No. 2. The mechanism acts much like a nervous system: it governs the movements and attitudes of the leaf by night or day. In the true Sensitive Plants, the leaflets fold up out of harm's way when touched. In most mimosas and acacias, however, they only fold at night, or in very cold or dark weather. Their folding is partly effected for the sake of warmth, because they then expose only one surface of each leaf; it may be compared to the way in which mice and other animals curl up in their nests, or to the habit of snakes in lying coiled up in holes, knotted together one with the other. But it is partly also done for physiological reasons: the plant rebuilds itself in sleep just as truly as the animal, and this posture seems to suit its growing and redistributing activities.

In No. 3 we have a branch of that common and beautiful little English wild-flower, the wood-sorrel. The plant is here represented wide awake in the daytime, its blossom expanded to court the insects that fertilize it, and its leaves wide open, drinking in its gaseous food as fast as they can drink it. Wood-sorrel is a tender and thin-textured spring herb; a chill is therefore highly prejudicial to its health: without being exactly delicate —for in a certain sense wood-sorrel may even be called hardy—it feels the need for taking care of itself. Severe cold nips it up: even gentle frosts have a bad effect upon it. But the wise herb has arranged against such adverse chances by the peculiar disposition of its dainty wan foliage. The leaves are composed of three leaflets each, and even at a casual glance, something about their mid-ribs might suggest to you the idea that they were intended for folding. And so they are. They fold quaintly downward—not one against the other, as in the mimosa, but half of each leaflet against the other half. In the sunshine and the warmth they expand to the utmost, as you see in No. 3; when

3.—WOOD-SORREL; THE FLOWER AND LEAVES BOTH AWAKE.

night falls they fall too, as you can observe in No. 4, where both leaves and flowers are fast asleep, resting after the arduous labours of the day in a profound slumber.

If you consider what the parts are doing in each case you will realize that day differs from night for the plant exactly as it differs for the animal—the one being a period of direct intercourse with external nature, and the other a period of repose, growth, and internal restoration. For during the daytime, the wood-sorrel swallows or sucks in with its leaves such carbonic acid as the wind brings its way, and then exposes it in the full sunlight to be assimilated and rendered useful: but by night it folds its leaves, just as the shopkeeper puts up his shutters or the mill stops work; it keeps them warm by contact with one another; and it begins to use up the material it has eaten for growth and development. Similarly with the dainty white lilac-streaked flowers: during the day they open their slender petals, hold up their heads, and receive the visits of the insects upon whom they depend for fertilization: but when night comes, and the insects have gone to bed, it is no use hanging out the sign any longer, so to speak—for the petals are just sign-boards to attract the eyes of the insect customers. Various misfortunes might happen to the flower in the cold spring nights, if it still kept open. The frost might nip up and wilt the petals: rain might fall and wash away the honey or the pollen: wind might disperse the fruitful golden grains, intended for the seed-vessels of sister blossoms. So the prudent plant imitates the little beasts which curl themselves up in their holes: it makes the flower hang its head and close its petals, so as to imprison warm air within its bell-shaped hollow. In this position, it is safest from rain, which can neither fill the cup so as to break the stem, nor dilute the honey, nor waste the pollen. Thus, all night long, the wood-sorrel suspends its business intercourse with the outer world, and retires upon itself for rest and recuperation; when morning comes again, it opens its leaflets to drink in the air and the sun, and lifts its flowers once more to attract the insects. Alike for warmth, for safety, and for economy, it sleeps by night; it wakes by day, and engages actively in the business of its existence.

I may add that we know otherwise how particularly necessary is heat to the wood-sorrel. If you examine the under-side of the winter leaves—I mean those few old leaves which manage to struggle on from the preceding year through an English January—you will find that they are distinctly reddish or purple. Now, chemists have shown us that this red or purple colouring matter which is spread on the under-side of the foliage in many plants is a substance with a curious power of catching the remnant of such light-rays as pass unused through the green cells of the leaf, and transforming them into heat-rays. To put it plainly, the red pigment is a warmth-catcher, a machine for transmuting light into heat. You therefore find it most often on

4.—WOOD-SORREL; THE FLOWER AND LEAVES BOTH ASLEEP.

the under-side of many early spring plants, which naturally need all the heat they can get, as well as on aquatic herbs like the water-lilies, whose under-surface is constantly

chilled (even in summer) by contact with the cold water. For example, the cyclamens so commonly grown in drawing-room windows in winter have bright purple under-sides to their leaves, because they grow and flower in the coldest months: so has an exotic wood-sorrel, which is a favourite pot-plant with cottagers, and which goes to sleep every night of its life, even more conspicuously than our wild English species. In every case where you light upon purple or red colouring matter abundantly present in leaves or shoots (as in sprouting peonies, and spring growth of rose-bushes), you may at least suspect that warmth is its principal purpose. Nature does nothing in vain: there is always a reason in the merest detail.

But you may ask, "Why do not all leaves equally go to sleep at night? Why have you thus to pick out a few select examples?" The answer is, all leaves do; but some of them sleep more conspicuously and visibly than others. The cases in which you can *see* that they sleep are those of plants with thin and delicate foliage, where the leaves or leaflets gain mutual protection against radiation and cold by putting themselves, so to speak, two layers thick. Very dainty spring foliage shows sleep most obviously: very thick and coarse leaves, like those of the cyclamen, the rhododendron, the Siberian saxifrage, or the common laurel, sleep without folding; they have warmth enough or glassy covering enough to resist injury. Here again we can see the analogy between the nightly and the winter sleep: thin-leaved trees shed their leaves in autumn: thick-leaved kinds, such as laurustinus, spruce-fir, and laurel, retain them unshed through the entire winter.

The sleep of flowers is even more conspicuous and more readily aroused than the sleep of leaves. Blossoms are delicate and much exposed. Foliage for the most part sleeps by night only: but flowers take casual naps now and again when danger looms in the daytime. This is only what one might expect; for the flower is usually the part of the plant which does the most varied external business and holds the most specialized intercourse with the rest of nature. The leaf has relations with the sun and the air alone; but the flower has to attract and satisfy all sorts of fastidious and capricious insect assistants: it has to produce pollen, honey, and seeds: it has to provide for its own fertilization and that of its neighbours. Hence, it may have to wake or sleep in accordance with the convenience of the outer world: just as a railway porter or a club servant must get up and go to bed, not when he chooses himself, but when his employers choose to make him. The rule with flowers is this: they open the shop when customers are most likely to drop in; they shut it when there is nobody about and when valuable goods like honey and pollen run a risk of getting damaged.

The purple crocus, illustrated in its working hours in No. 5, is an early spring flower which has to open under considerable disadvantages. It lays by material during the previous summer in an underground bulb, sleeps the winter through, and pushes up its head in the very early spring, at a time when frost and snow are still extremely probable. All such early spring plants, I need scarcely say, are naturally hardy: they also wrap themselves up warm in blankets and overcoats. The crocus bud when it first emerges is folded tight (like an Indian pappoose or an Italian bambino) in a neat and commodious papery coverlet: it only peeps out of its close-fitting mummy-case when the weather promises a chance of successful flowering. A little break of warmth in February or March, however, suffices for its purpose. It will unfold its purple corolla gaily in the sun, and flaunt its golden-yellow stigma in the midst of the blue cup to allure its winged allies to the store of honey.

These allies are all of them bees, dozens of whom venture out on the prowl on sunny days through the whole winter. It is for them that the gorse hangs out its nutty-scented flowers: for them that the crocuses, golden or purple, expand their chalices. As long as the sun shines, in spite of cold east winds, the bees bury themselves deep in the tempting blossoms, dust their hairy thighs with quantities of pollen, and rub it off against the feathery and sticky stigmas of the next flower they visit. But spring sunshine is not a joy to count upon. Great white clouds roll up and obscure the clear blue sky; a cold wind accompanies them; the bees hurry off, full-laden, to their hives or their underground nests; rain, sleet, or snow threatens. The prudent crocus perceives that all chance of business is over for the present, and, like a booth-keeper at a fair, when the crowd has gone, it proceeds to shut up its shop and take care of its merchandise. And it is well advised, for its shape renders it peculiarly liable to damage from rain or sleet when open; so it closes its corolla, as you see in No. 6, making the folded lobes do duty as an umbrella. If rain or snow comes, it is thus effectually protected: the pollen is not washed

away, nor is the large and fleshy stigma ruined. You will find these tactics common among cup-shaped or chalice-shaped flowers like the crocus and the tulip: they never occur

5.—PURPLE CROCUS, OPEN IN SUNSHINE.

among bell-shaped hanging flowers, like the harebell or the wild hyacinth, where the whole blossom, being turned downward and entered from below, forms a perpetual umbrella to guard its own pollen and its own honey from stress of weather. These last are a higher and more evolved type, belonging for the most part to very advanced and progressive families.

Most spring flowers, however, in their anxiety to attract the few insect visitors who are about at that treacherous period of the year, keep open door, and spread their blossoms, cup-like, upward. Examples, other than the crocus and the tulip, are the winter aconite, the buttercup, the wood-anemone, the Alpine gentians, the globe-flower, and the hepatica. Most of these early flowers shut up for every passing cloud, and open again for every gleam of sunshine. They are hard at work all the time, opening and shutting as the weather changes. On a typical April day I have often noticed the yellow crocuses expand and close half-a-dozen times over.

A great many flowers which have the honey and pollen openly exposed in this cup-like way are much given to closing, even in summer, for every cloud that passes, because they are naturally so afraid of being spoiled by a wetting. This is particularly the case with the wheel-shaped forms—those, I mean, with open flat saucers like the common pimpernels. An old English name for our little red pimpernel is "shepherd's weather-glass," because it opens its eyes in the broad sunlight, but closes them at once in shade or when a cloud passes. Plants of this type sleep all night long habitually, but also take a gentle doze every now and again when danger lowers. So fowls have been known to go to roost during a total eclipse of the sun, and many small birds settle themselves to sleep in dark and gloomy weather.

In No. 7 we have a branch of the common wild geranium or herb-robert, a well-known English weed, which exhibits this peculiarity in a marked degree. Here you see three flowers awake and expanded, with their pretty purple petals (marked by darker lines or honey-guides) flaunting in the sun as advertisements to the insects. The lines on the petals are not there for mere ornament: they point straight to the honey, and so save the time of the visitor, by showing him at once where he should stick his inquisitive proboscis in search of it. But No. 8 exhibits the very same branch in the evening or when clouds are obscuring the sun. Danger now looms: a shower threatens. So what does the frightened wild geranium do? Observe that the

6.—A CLOUD PASSES; THE CROCUS CLOSES TO PROTECT ITS POLLEN.

overblown flowers, the buds, and the leaves retain their positions as before: rain cannot hurt them. But the three open flowers bend their heads against the storm, instead

of closing their petals: they convert themselves into an umbrella, thus temporarily imitating the tactics of the bluebells and the snowdrops. By this simple device, the honey and pollen are secured from danger. When day or sunshine returns, the geranium raises its lolling heads again, because its flowers are small and inconspicuous: they depend upon minor insect visitors—flies or the like—and cannot afford to do without the display of their purple upper-side, like the far more noticeable hyacinths and harebells.

7.—WILD GERANIUM, LAYING ITSELF OUT TO ATTRACT INSECTS.

A different method of compassing the same result is seen in that queer English weed, the carline thistle. It is a very common plant on our chalk downs, and on many dry hillsides: it abounds, for example, on Box Hill: and yet, if you are not a botanist, I greatly doubt whether you will ever have noticed it. For it is a curious creature which always looks dead, even when it is most alive: you can see it in No. 9 much as in real life, only you must remember that its colour is almost that of a dry dead thistle. Its leaves are cottony; its flowers are dingy in hue; and its general aspect is suggestive of death, decay, and dissolution. Yet it is really very much alive: and its form is so admirably adapted to its place in nature, that I think before I describe its mode of sleeping I must first devote a few lines in passing to its other dodges for picking up an honest livelihood.

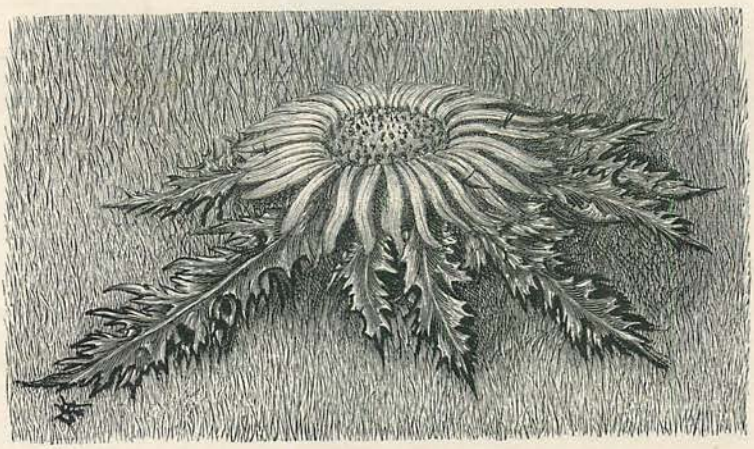
8.—WILD GERANIUM, AT NIGHT OR IN CLOUDY WEATHER, MAKING EACH FLOWER INTO AN UMBRELLA FOR THE PROTECTION OF THE POLLEN.

The carline grows only on dry fields, high open sheep-walks, and sandhills by the sea. All these places are, of course, much liable to be browsed over by sheep, cattle, donkeys, and other animals, not forgetting the destructive rabbit and that strangest of all grazers, the goose—a bird which puts itself into competition with the herbivorous ruminants, and crops the meadows with its bill shorter and closer than any of them with their teeth. Now, all plants which live under such conditions are obliged to adopt protective measures against animal depredators. Most of them are prickly: such are gorse, blackthorn, and the common thistles: nay, there are even certain herbs, like the pretty pink rest-harrow, which are unarmed when they grow in inclosed meadows, but which produce a special prickly variety when they occupy spots exposed to donkeys, rabbits, and geese, the worst and deadliest of grazing enemies. Other plants defend themselves in subtler ways, by bitter juices, or by unpleasant hairs dotted about over their surface. Yet others, like the subterranean clover, bury their ripening pods underground, so that their seeds at least may escape the keen-eyed depredators. The thistles of rich meadows have long stalks and rise a foot or two high: but on the fine sward of chalk downs, a special species has been developed, known as the Stemless Thistle, which consists simply of a rosette of prickly leaves, in whose midst a compact head of flowers lies pressed close to the ground, and well protected by the prickly points of the leaves around it. Indeed, the whole nibbled turf of the downs consists everywhere of creeping or low-growing plants, specially designed to flower and fruit, and so reproduce their kind, in spite of the murderous assaults of animals to which they are continually subjected.

It is in the midst of such a stunted world as this that the carline has to carve itself out a niche in nature. Its leaves, as you can see in No. 9, are pressed flat against the

ground, looking almost as if they had been trodden into it—a peculiarity still more noticeable in the specialized form of plantain evolved in chalk country, on whose lawns it is a weed much hated by gardeners. These leaves are intensely prickly, with long and rigid spines protecting them at all angles from the attacks of nibblers. The whole carline plant is remarkably rigid and juiceless; in winter it looks absolutely dead, but revives again in spring as if by a miracle. In the centre of the rosette of spiny leaves a flower-head develops, looking at first sight like a single flower, but consisting really of many tubular bells, clustered together in a round group, and inclosed by an involucre or prickly basket of bracts. The inner bracts of this basket are long, slender, and ray-like: in texture they are thin and shining like straw, while in hue they are of a pale straw-colour, so that they add altogether to the dead-alive aspect of the plant. But when these shining straw-coloured bracts are spread out horizontally in the sunlight, forming a crown about the true flowers or little bells in the centre, they produce precisely the effect of petals, and serve the same purpose in attracting the notice of the fertilizing insects. No. 9 shows you the aspect of the carline in these its most alluring moments, when it is laying itself out to be agreeable to visitors.

That is the attitude it always adopts in bright dry weather, when the winged guests on which it depends for fruiting are around and active. Its bracts then spread out like the rays of a star, and mimic the true ray-florets of a daisy or a chrysanthemum. But when the air becomes damp, the bracts, which are highly sensitive to moisture, curl up of themselves, as you see in No. 10, and form a sort of hut or shed above the true flowers in the centre. The conical tent or pent-house thus produced makes a shelter against the impending rain, which would wash away the pollen and dissolve the honey. The illustration shows you very well the general arrangement of the plant and its parts, consisting outside of a rosette of spinous leaves, and inside of a basket or involucre to guard the flowers: this involucre itself being once more composed of two distinct parts; the outer layer of prickly and protective bracts, designed to ward off browsing enemies, and the inner layer of thin, dry bracts, with a shiny texture like that of everlastings, designed in dry weather to play the part of petals, and in wet to rise up as an umbrella or rain-shelter.

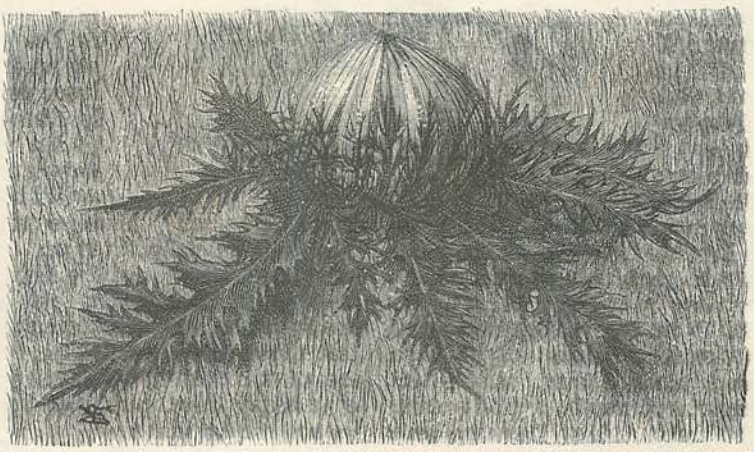


9.—CARLINE THISTLE, ITS BRACTS OPEN AND ACTING LIKE PETALS TO ALLURE INSECTS.

The word carline is good old English for a withered old woman, a wizened witch, and it is very aptly applied to this curious and tattered grey weather-beaten species. Robert Burns applies it to the hags whose orgies were interrupted by Tam o' Shanter.

Most plants and most animals sleep by night and wake by day. But there are of course a number of kinds, both in the animal and vegetable world, which find it pays them best to be nocturnal. Day is the time when most enemies are abroad: therefore, to get the better of the enemies, it may be well to sleep by day and turn out in the twilight. Defenceless species, no doubt, begin the game: they fly abroad in the dusk to secure safety

from birds and other aggressive foes. That is the policy of the moths, the fireflies, the mosquitoes, and many other night-flying insects. Then the bats and the night-jars discover in turn that it is worth while to prowl about at night, in order to swoop down upon the insects which have thus tried to escape from the swifts, the swallows, the martins, and the fly-catchers. Similarly, the smaller mammals, such as mice and shrews, go out by night in search of beetles : and the owls follow in search of mice and shrews. Thus the larger half of nature is by habit diurnal, while the smaller half has become nocturnal, either to escape its enemies or to capture its prey. It is like the human case of guns and armour : we make armour-plated ironclads so thick that no gun can pierce them ; then we invent new guns which can pierce even the impenetrable armour. Nature is one vast game of check and counter-check : it consists of devices intended to outwit other devices, and themselves outwitted in turn by devices still more stringent or more marvellously cunning.



10.—CARLINE THISTLE : CLOUDY WEATHER OR NIGHT : THE BRACTS CLOSE AND FORM A PENT-HOUSE TO PROTECT THE FLOWERS.

Now plants too have followed the general fashion of producing nocturnal types, wherever the circumstances rendered it desirable for them to do so. The night-flying moths are in many cases honey-eaters, therefore they may be utilized as carriers of pollen by any enterprising plant that chooses to lay itself out for securing their services. Here are so many Pickford's vans, as it were, going begging : the plant that chooses to flower at night and close by day will be able to get its fertilization done cheap, with greater certainty than if it had to compete with the ruck that opens every morning. So a great many flowers have taken the hint and laid themselves out for this twilight blossoming. I will give you one simple example first, and then pass on to more complex cases.

Everybody knows the common English red campion—the day lychnis, or Robin Hood as it is often called in the country. It is a pretty pink flower, scentless and somewhat weedy, and it grows abundantly in hedgerows all over England. It is pink, because it is principally fertilized by day-flying butterflies, which love bright colour : it needs no perfume, because its brilliant hue is sufficient advertisement for all practical purposes. But it has a very near relation, almost exactly like it save in two respects : and this relation is the white evening lychnis or night-flowering campion. It differs from the red campion, first in colour, and second in being delicately and pervasively scented. Why ? Because it opens its blossoms about five or six in the evening, in order to catch the night-flying moths. These moths are chiefly attracted by white flowers, which show up best in the grey dusk of evening : and they are also guided very largely by scent, so that blossoms which lay themselves out for the patronage of moths are almost always heavily perfumed.

A few more examples will show you some other peculiarities of this group of night-blooming moth-alluring blossoms. Everybody now knows the so-called "tobacco-plant" or Nicotiana affinis, so greatly cultivated of late

in gardens. This beautiful and graceful flower closes during the day, but opens at nightfall, when its pure white blossoms become strongly scented. If you are at all in the habit of noticing flowers, too, you must have observed that the "tobacco-plant" is almost self-luminous in the dusk: it glows with a strange phosphorescent light, as if illuminated from within. This is the case with many nocturnal flowers, and I suspect (though I do not know) that the property is connected with their insect-eating habits, about which more by-and-by. Again, you may note that there are a large number of similar night-flowering plants, all of them moth-fertilized, such as gardenia, white jasmine, tuberose, stephanotis, night-flowering cereus, and so forth. All of these are pure white, and all of them are heavily scented with very similar perfumes. Moreover (and this is a curious coincidence), none of them have any streaks, spots, or lines on their petals. The reason is simple. Such streaks or lines are always honey-guides, to lead the insect straight to the nectary. Day insects see such lines and are greatly influenced by them: but at night they would be useless, so their place is taken by scent and by deep tubes, which make a dark spot near the centre of the blossom. What night flowers need most is a bright white surface which will reflect all the small light they can get: and this I suspect they sometimes supplement by a faint phosphorescence.

The Nottingham Catchfly, which you see asleep by day in No. 11, is a highly developed example of these nocturnal flowers. During the daytime it covers its blossoms by bending its petals inward, so as to preserve its honey from casual diurnal visitors, and keep it till night for the regular customers. At evening it opens them again, as you see in No. 12, displaying its brilliant white inner surface, which is dazzling in its purity. But why, you may ask, does it not avail itself of the day insects as well? Because they are not the ones specially fitted to do its work: their heads are not of the right shape: the Nottingham Catchfly has laid itself out for special moths, and has so formed its blossoms that those moths can fertilize it most easily and most economically. It is a good example of a highly developed type, specially fitted for a particular visitor.

11.—CATCHFLY, A NOCTURNAL PLANT, SLEEPING BY DAY, WHEN ITS MOTHS ARE ABSENT.

The name of Catchfly, again, it owes to an odd peculiarity which it shares with many other nocturnal flowers. The top of the stem at the flowering period is covered with sticky hairs, which have glands at their tips: and these glands exude a peculiar viscid liquid. Small flies light on the stem, and are caught by the sort of bird-lime thus prepared for them; the plant then digests them and sucks their juices. I do not know whether my next guess is correct or not—I am not chemist enough myself to verify it: but I am inclined to conjecture that the plant uses up the phosphates in the bodies of the insects in order to produce the peculiar luminous appearance of the petals in the twilight. I leave this hint for those of my readers whose chemical skill may be greater than mine is.

12.—CATCHFLY, OPENING ITS WHITE PETALS AT NIGHT, WHEN ITS MOTHS ARE FLYING.