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VIGNETTES FROM NATURE.

BY GRANT ALLEN.

AUTHOR OF "THE EVOLUTIONIST AT LARGE,"

PREFATORY NOTE.

These little essays have no pretension to be any more than popular expositions of current evolutionary thought, occasionally their author's, oftener still other people's; but they may perhaps do a little good in spreading more widely a knowledge of those great biological and cosmical doctrines which are now revolutionizing the European mind, and which owe their origin to the epoch-making works of Charles Darwin and Herbert Spencer. G. A.

T FALLOW DEER.

UNDER the great horse-chestnut trees in Woolney Park the broad circle of shade is now pleasant enough to attract the does and fawns of the fallow deer, who lie in pretty groups upon the grass, or stray about, browsing, beneath the heavy boughs thick with scented blossom. To-day I have brought out a few scraps of bread in my pocket, and the fawns are tame Celtic and Euskarian aborigines. For enough to come and eat it from my though some good authorities will hand on the open; for they have less have it that the fallow deer date back fear of man here than in any other no earlier in this country than the place I know of, except perhaps in the days of the Romans, who are said to Magdalen grounds at Oxford. They have introduced them for their pleawill even allow a favorite acquaintance sure grounds, I myself can hardly to stroke and fondle their pretty heads. doubt that they are a part of our old No doubt the long domestication of indigenous fanna, which now survives their ancestors has made them natu- only in a few enclosed preserves. The rally prone to strike up a friend- wild white cattle at Chillingham, the ship with human companions, just as red deer on the Scotch moors, and

| very near the great house itself, where children and visitors have long been wont to pet and caress them. There are, indeed, few more interesting relics of the past in England than these stray herds of dumb creatures, remnants of the native woodland tribes which once spread over the whole well-timbered country, and which now carry us back in mind past the days of Robin Hood and of William the Red to the old forestine life of the is the case with kittens and puppies; these pretty does and fawns in Wool-and at Woolney they have always lived ney Park, all trace back their ancestry,



I believe, to the time when England | was clad by one almost unbroken remains we meet with in the lower sheet of oaks and beeches, and still tertiary strata were all hornless. earlier to the time when a great belt of land connected it with the Continent from Holland to Portugal. Even camels, the llanas, and the alpacas, the veriest Red Radical like myself though, of course, these kinds are may well share John Mill's hope that far more specialized in other ways the spread of agriculture and political than were their primitive ruminant economy may never succeed in improving these dear dumb friends and pensioners of ours off the face of the earth. They are one of the beautiful iinks which bind us to the pre-human past; and I hope we may hand them on as part of our common heritage to those who will follow us hereafter in a higher and more human future.

Evolutionism, it often seems to me. throws a wonderful charm of this halfhistorical sort around every beast or bird or plant in the meadows about These fallow deer are no longer 118 mere accidental animals happening to live in the park here at the present day: they are creatures with a whole past history of their own, as interesting to the eye of the evolutionist as a castle or an earthwork to the eye of an archæologist, and as a cathedral or a temple to the eye of Mr. Freeman or Mr. Fergusson. We have all been living all our lives in the midst of a veritable prehistoric Ilium, will all its successive deposits and precious relics lying loose about us, and we needed only a Schliemann to tell us what it all meant. Mr. Darwin and Mr. Herbert Spencer have read the riddle for us, and in doing so they have given us a key which will help us to unlock, each for himself, a thousand little secrets of nature that meet us every day, on our way through the world, at every turn. These fallow deer, for example, have a quite recoverable pedigree, which shows us just by what steps they have been developed from an early common ruminating ancestor; and this pedigree M. Gaudry has worked out for us in detail as admirably as Professor Huxley has worked out the genealogy of the horse, and as Dr. Mivart has worked out that of the cat.

The very earliest ruminants whose The resembled in this respect a few abnormal living kinds, such as the ancestors. But as time went on, the wager of battle among the males, common to so many races of mammals, produced singular results upon the whole ruminating tribe. The nature of their food prevented them for the most part from fighting with their teeth, like carnivores, so they took to butting with their heads in-Thus, either by accidental stead. variations, as Mr. Darwin thinks, or by use and wont, as Mr. Herbert Spencer rather believes (with more probability, as it seems to my humble judgment), aided in any case by natural selection, almost all the ruminants grew at last to have horns or antlers of one kind or another. But these weapons of rivalry-for they are all but useless against other speciesdiffer greatly in their structure, and therefore in their origin, between race and race. All that is CO11stant is the presence of some kind of offensive butting instru-ment upon the forehead. In the bison and ox tribe, including the antelopes and goats, the weapons take the form of real horns-that is to say, of hollow permanent dermal processes; in the deer tribe, they appear as antlersthat is to say, as deciduous bony, not horny, structures; and in the giraffe they exist in the shape of permanent bosses of the skull, covered with hair and skin, but used very fiercely in combat, even in Regent's Park, where one giraffe once actually drove his horn clean into the skull of another. Only one very abnormal ruminant, the musk deer (which is not really a deer at all, but a specialized aberrant descendant of the old undifferentiated ancestral type), has weapons of a different character-a pair of curved tusks in the upper jaw, used in the

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The historical development of antlers in the deer tribe is very marked. While the group was still young and dominant, with the open grass-clad tertiary plains all before it, and with plenty of elbow room to spread and multiply, it had as yet no weapons of offense of any kind. But as the races grew thicker and more numerous, and as space failed the younger generations-for deer, like men, are subject to the inexorable logic of the Malthusians-the fathers of the herd began to fight among themselves for the possession of the does, and only the strongest survived to become the parents of future deerkind. Butting naturally produces hard bosses or protuberances of some sort; and in the ancestral deer these protuberances took the shape of bony projections on Again, those deer the forehead. which had the most marked and most pointed projections would best van quish their rivals, and so fare best in the struggle for the hinds. Their descendants would inherit their peculiarities with more or less variation ; and would similarly be selected by the law of battle in accordance with their fighting powers and the fitness of their weapons.

Now this probability, set forth \dot{a} priori by Mr. Darwin, exactly tallies with the geological record, as interpreted by M. Gaudry and Professor Boyd Dawkins. The very vague and unspecialized deer of the lower miocene period had no antlers at all; they were somewhat like musk-deer without the tusks, or like young fawns in their first summer. But in the mid-miccen; antlers make their first appearance as mere short pointed knobs; next, they develop a single side tine; and in the upper miocene they come out as fully evolved as in our modern species. Every intermediate stage can be traced between the mere nascent boss like that of a budding roe in our own day, and the many-branched headpiece of the exist- all previous seasons.

same way as those of the wild boar. ing reindeer. Indeed, one late tertiary species had a pair of wonderfully intricate antlers which far surpassed in complexity those of any living elk; but, like many other highly specialized creatures, this over-developed type seems to have fallen a prev to the great extinct carnivores of the same period. Before the advent of man, many such high types existed, and they may perhaps have been partly destroyed by his monopolizing all the most open and desirable plains as his special hunting grounds. For we now know that man is certainly a quaternary, and probably a tertiary genus as well; and, even in his lowest and humblest form, his intelligence must have made him from the very first a dominant race and the real lord of creation.

> It is interesting to note, too, that the historical evolution of antlers in the deer tribe is exactly paralleled by the modern evolution of antlers in every individual red deer. In the first year a stag has no horns at all, and is technically known as a calf. In his second year he puts forth a pair of rounded bosses, and is therefore called a knobber in the slang of the gillies. With his third year the knobs. fall off, and are replaced by longer horns, called dags, while the staghimself is now known as a brocket. Thus, year after year, the growing deer reproduces one stage after another of the ancestral development, till at length the top of the horn expands into a broad crown, and the beast is then finally dubbed a hart or "stag of" ten," from the number of tines on eachof his antlers. It would be quite possible to pair the cast horns of each year tolerably exactly with corresponding adult horns from the successive tertiary strata. Every deer in fact recapitulates in his own person the whole evolution of his race, the antler of each successive year being different, not only in size, but in form and arrangement as well, from those of

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II.

SEDGE AND WOODRUSH.

SITTING here on the edge of the low wall that banks upon the meadow against Cannington Lane, I can pick, without stooping, half a dozen different kind of grassy-looking weeds, all first sight you would say it was merewithin easy reach of my hand, in the field behind me. The sun is shining brightly through the horse-chestnut branches, the west wind is blowing gently over the valley, and the day is warm enough to tempt a little loitering under the scanty shade of the young foliage overhead; so I cannot do better than pick and examine a few of these unnoticed flowers, whose against the brown background of the pale yellow spikelets are hardly conspicuous enough to attract the notice of any save a botanical eye. Grass, most people would call them; and indeed their leaves are grassy-looking blades enough; but a single close tentively into the tiny rosettes. And glance at their reedy stems and clustered flower-heads would suggest even to the unpracticed observer that their stalks and blossoms differed widely from the little scaly panicles almost undoubtedly a faded and colof the true grasses.

To my thinking, there are few plants so pretty as all these small, insignificant - looking, unconsidered look of the dry, brown petals. Every weeds, whose flowers need to be examined somewhat minutely before we or green or inconspicuous, has once can fully appreciate the real beauty been a bright and flaunting flower; of their form and arrangement. Any- for the sole object of petals is to atbody can see and admire at once a tract the eyes of insects, and they are foxglove or an orchid, but not every-*therefore* found nowhere but among body can see and admire at once the insect-fertilized plants or their degendelicate gracefulness of spurges and erate descendants. Flowers which quakegrasses, of little waving sedges have always been fertilized by the and tufted woodrushes. One feels wind never have any petals at all, that the beauty of the larger blossoms brown, green, or otherwise ; but flowis something flaunting and meretri-lers which are fertilized by insects have cious-an Aphrodite Demosia tricked them red, white, blue or yellow, and out in gaudy colors to please the flowers which have once been so fermost careless passer-by; whereas the tilized and have afterwards relapsed tiny green and brown flowers of the almost always retain some memorial fields and hedgerows appeal to a of their old estate in the shape of more esoteric circle-aselect few who dwarfed and colorless petals, whose can sympathize with nature in her function is gone, while the rudiment-more sombre as well as in her bright- ary structure still survives. They er moods

side of nature, but Il Penseroso is the poet's.

Look, for example, at this tall stalk of woodrush, its stem clasped by two or three drooping and pensile leafblades, and its tory crowned by four or five thickly-clustered heads of small brown five rayed flowers. At ly a bit of grass with a brownish top to it; but gaze a little closer and you will see that the heads consist each of half a dozen tiny regular blossoms of a very pretty, fantastic sort. Each blossom has six dry, brown petals, with silvery, thin, transparent edges; and in the middle, as many bright yellow stamens stand out delicately corolla. Every one of them is like a sombre copy in miniature of a lily or an amaryllis, not very striking to a careless observer, but marvelously pretty and perfect when you look atthe history of these dry, brown flowers is in itself curious enough to make them well worth a moment's examination. For the woodrush is orless descendant of some once eolored and brilliant ancestor. You may be fairly sure of that from the mere blossom with petals, however small L'Allegro is the world's point back, like the fasces of the Byzant of th 0

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Our fields are full of such degenerate flowers, with green or brown corollas, sometimes carefully tucked out of the way of the stamens, so as hardly to be seen unless you pull them out on purpose: for, contrary to the general belief, evolution does not by any means always or necessarily result in progress and improvement. Nay, the real fact is that by far the greater number of plants and animals are degraded types-products of retrogression rather than of upward development. Take it on the whole, evolution is always producing higher and still higher forms of life; but at the same time stragglers are always falling into the rear as the world marches onward, and learning how to get their livelihood in some new and disreputable manner rendered possible by nature's latest achievements. The degraded types live lower lives, often at the expense of the higher, but they live on somehow; just as the evolution of man was followed by the evolution of some fifty new parasites, on purpose to feed upon him.

It would be wrong to suppose, however, that these dry brown petals in the woodrush have now no function at all: they have found out a new one to which they have adapted themselves, although the old one of attracting insects has passed away. Whenever and however the woodrush took once more to the primitive and wasteful method of fertilization by the wind we cannot say. But it is a low, lithe, grass like plant, growing with the grasses in the wind-swept meadows; and almost all the plants of the same habit and habitat are wind-fertilized as well. Living, as they do, in great numbers close together, with bending stems and often feathery heads, they do not seem to waste so much pollen as other, taller, and more scattered flowers would waste, if obliged to trust to the breezes alone for its dis- further than the woodrush on the persion. At any rate, almost all wind- downward path of degradation.

zantine emperors, to the past glories some plan for preventing the pollen of each blossom from falling upon its own pistil, and so producing poor, weak, self-fertilized seeds. They almost always display some curious device, to insure a cross with the neighboring flowers. In the woodrush the thin papery petals have been utilized in a manner subsidiary to this new object. They were no longer of any service in attracting insects, but they have been very simply diverted to another function. Here I have picked one of the younger heads with the blossoms yet unopened. From the top of each flower a long white plume of three waving filaments-a Prince of Wale's feather in miniature-protrudes through the tightly closed petals. These plumes are the sensitive surface of the pistil: and to them the pollen-grains are blown from other surrounding blossoms, already fully opened. As soon as the seeds have thus been impregnated, the little plumes wither away, and then the petals, which have hitherto covered the stamens, open immediately, releasing the stamens, as you see them in the first head I plucked. The pollen blown from them falls upon some other flower still in the bud; and so each head as it opens fertilizes in turn its unopened neighbors. You can gather lots of them here in every stage of blossoming, from the first receptive period with hanging plumes and tightly covered stamens, to the last distributive period with open petals and stamens shedding freely their golden pollen-grains.

This pretty nodding sedge, on the other hand, shows us another way of solving the self-same problem—how to prevent the pollen from falling upon the pistil of its own blossom. The sedge has done it very simply, by putting all the stamens in one head of flowers at the top, and all the pistils in another head at the bottom. Look closely into this plant again, and you will see at once that it has gone even Itfertilized plants are obliged to have has no trace of petals at all; indeed, it.

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is possible that it has never had any; and the bronze-mailed beetles are though, judging from its close rela- hunting for smaller insects beside tions and the numerous intermediate the matted stems and roots of the big forms, it is more likely that it once white stitchworts. The gorse has had them, but has now hopelessly lost them-as hopelossly as the snake has so bright that one can hardly wonder However this may be, lost its legs. the flowers of the sedge are now arranged in a thoroughly business-like first he looked upon its golden glory. manner for wind fertilization. Each Up to this morning I have counted stalk bears three or four little branching spikelets, the top spikelets consist- blossom, not including catkins or ing altogether of yellow stamens, cov- grasses. And now to-day, for the ered in groups of three by single rus- first time this season, I see the pretty set-black scales, while the lower spikelets consist altogether of pistils, with ing their warmer tint to the blues and two or three white feathery plumes yellows and greens of the tangled hanging out to catch the pollen, and bank beside me. Already the buttersimilarly covered by dark sheathing flies have found out th t its big bracts. The whole head thus looks swollen buds have opened and made like a group of miniature catkins, the clear the way to the nectaries; and I upper eatkins bright yellow and the can notice a great bustling hairy under ones delicately frosted with bumble bee blundering about the fluffy white. The use of this arrange- mouth of one flower on the stalk, ment is obvious. When the wind while half a dozen little flies are shakes the heads so that they bend and gathered around the sticky calyx of jostle against one another, the tallest another. Evidently the red campion spikelet on each stalk naturally strikes is very successful in its efforts to against the lower spikelets of its neigh- attract the eyes of insects. I saw it bors. Thus each plant fert lizes the distinctly a hundred yards away, and next in order; and even if the heads the butterflies seem to see it quite as do not happen to touch, yet the pollen blown from the one falls forward upon the other, so producing exactly the same result. Indeed, cross-fertilization is brought about in different plants by a hundred such devices; and to observe the various mechanisms by which it is furthered, forms a fresh and almost endless pleasure for every country walk.

III.

RED CAMPION AND WHITE.

leads from the village to Culverhole ively, but to village children as red Cliffs is just at present all aglow with and white campion. The corresponda varied wealth of flowers and insect ence of these two names is full of life. are flitting over the blue masses of bright pink blossom, quite scentless, wild hyacinths: the ladybirds are and opening in the morning. It is busy among the wee green aphides specialized for fertilization by bees on the budding sprays of honeysuckle; and butterflies (more particularly the

burst into its wonted blaze of blossom, at Linnaus, who fell upon his knees and thanked God with fervor when seventy-eight kinds of wild flowers in pink clusters of the red campion addwell, and a great deal more effectually.

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The campions, indeed, are flowers in which specialization and adaptation have in many respects been carried to an extremely high pitch True, they cannot compare in complexity with the orchids or the dead-nettles, nor even with the little daisies and dandelions around them. Yet in their own way they have found themselves a place in nature which they are well fitted not only to fill but also to adorn. There are two common kinds in England, known to botanists as THE bank along the footpath that the day and night lychnis respect-The yellow cabbage-butterflies significance. The day lychnic has a

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latter), which are color-loving insects, cannot be seen by persons of robust and which hunt by sight mainly, and vigorous sight. Women and ar-always during the hours of sunlight, tists perceive it oftener than men of The night lychnis, on the other hand, science, which no doubt tells rather has white blossoms, opening in the hardly against its objective reality evening, and faintly scented with a Yet perhaps they and the moths can vague but pleasant perfume. It is see some things which are hidden specialized for fertilization by moths, which fly at night, and which have sight not adapted to the perception of Mr. B. T. Lowne has made on the side of the poets. color. some interesting microscopical studies of insects' eyes, and has shown that campions, to return once more to solid the eyes of moths correspond to those | science, form a very instructive study of owls among birds, in the absence in the origin and growth of specific of certain nervous elements supposed distinctions. In most points the two to be the organs of the color sense; while the eyes of bees and butterflies correspond to those of day birds in the presence of such organs. In fact, it is clear that a color sense would be of little use to nocturnal or crepuscular animals, because the amount of light in the evening is seldom sufficient to show up the distinctive colors than new species in the making. They of different objects.

Hence almost all the flowers which appeal specially to the moths are like the monstrosities which we cultieither white or pale yellow-good reflectors in the twilight or moonlightand they are invariably scented, sometimes very strongly. Many of these white and perfumed night blossoms are great favorites in our gardens and conservatories-for example, jasmine, stephanotis, tuberose and self already the product of much senight-flowering cereus. Some of them lective action. actually close up during the day, and not the red one, is the divergent varimost of them emit their perfume only in the evening, when the moths on liarities, notably from the fact that which they depend for fertilization most of the lychnis tribe have pink are abroad. Moths, indeed, hunt flowers, and that no other British mostly by smell, though they are also species has white ones. partly guided by sight, and perhaps even in part by the faint phosphorescence, hardly visible to human eyes, which, as the daughter of the great then they may perhaps chance to at-Linnæus first observed, plays lambent | tract the eyes of some passing moth, over certain of their favorite blossoms in the early shades of night. I have in its search for honey carrying the seen this phosphorescence myself (or pollen from head to head. Thus a fancied I saw it) on the petals of the second generation of night-flowering evening primrose; but only a few campions would be set up, still with people have weak enough vision to bright pink blossoms. But the color detect it, for, like negative images, it of petals is always more or less vari-

from the wise and learned; at least, I like to believe so, and to persuade myself that I, too, am in this matter

The differences between the two plants are absolutely alike, and even the technical botanists, who never miss a chance of manufacturing a new species where possible, admit that they are perhaps mere varieties of a single form. But then these varieties, especially when so markedly dependent upon difference in function, are nothing less are nascent stages of fresh types. An accidental variety of leaf or flower, vate in our gardens, means, as a rule, very little indeed, because it is not correlated with any used or habit of the plant. It affords no material upon which natural selection can work. But a variety like the white campion has of course a distinct meaning, and is it-That the white form. ety, we may infer from several pecu-

Suppose, however, that some of these pink campions take (at first by some accident) to opening at night, and so to get fertilized by the insect

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tional needs; and so some of these evening varieties would be pretty sure to have more faded and whitish flowers than others, and these would best spite of backward weather, the cabattract the eyes of the fertilizing bage butterflies were already airing moths, and oftenest accordingly suc ceed in setting their seed. After long sun, above the tall lilae sprays of the generations of such unconscious selection, the white-petalled individuals would establish themselves as a permanent race; though even to this day the original pinkiness of their constitution has not wholly died out. It reasserts itself from time to time; for you may often find scented evening campions with very pale pink petals, recalling the old type of the race, just as amongst ourselves a particular bone, or tooth, or eyebrow sometimes still recalls the ancient anthropoid peculiarities. By somewhat the same process the extra attraction of seent must have been acquired. Even the date flowering has accommodated itself to the new conditions, for the red cam-, pions are now all coming into blossom | again on another brown cluster a few and will soon be ont in every hedge- yards off. I creep slowly up towards row, while the white ones do not it, and examine the locomotive leaf as open for at least another fortnight. it stands. It is a little brown butter-There are plenty of butterflies now in fly, with folded wings, fresh from the the warm sunshine at noon; but the chrysalis; and the lower or outer nights are still far too chilly for moths surface, which alone is visible as it to venture ont as yet from their com- sits, seems dappled over with wee fortable cocoons. A white lychnis light spots, much like the spots of deflowering this week would therefore find its life thrown away, with no friendly insect at hand to help it in setting its precious seeds. Thus all those which blossomed too early have been slowly weeded out, and only the late-flowering individuals have at last been left to perpetuate their kind.

IV.

BUTTERFLY-HUNTING BE-GINS.

THE Lammas Fields are now positively thick with various butterflies, so I have come out this brilliant afternoon to watch and make notes, as my wont | birds and other hostile creatures as it is, on their habits and manners. The sits still, and so it requires to resemble first of May is to the naturalist what the ground, leaves, or twigs, on which the twelfth of August or the first of 'it usually settles, in order to deceive

able, being only kept straight by func-|September is to the sportsman-it is the real opening of his year, the date when flower-hunting and butterflyhunting both begin. On the 2d, in their sulphur-yellow pinions in the lady-smocks. Two days later the dragon-flies were darting after midges above the boggy hollows, and the banded hedge-snails were congregating in numbers among the young pale-green foliage of the hawthorn bushes. On the 7th, we had a cloudless blue horizon and warm sunshine, and I saw an orange-tip plimming its unexpanded wings and displaying its beautiful markings on a blade of grass beside the brooklet. This evening, under a mackerel sky, like July weather, I have just been watching a motionless bunch of dry brown leaves on the hedge bank. Suddenly one of the leaves gets up, flutters about in the air a bit, and then settles down cay upon the leaves among which it hides. I clap my hands briskly, and it gets up hastily, opens its wings to the sunshine, and shows itself off at once as a red-streaked beauty in all its glory. It is not difficult to see that the difference of color in the two sides of its wings must be designed for some special purpose, and that the purpose of the under side is to escape detection, while the purpose of the upper side is to attract attention.

> The protective use of the brown under wing is very simply explained. The insect must be much exposed to

the e people tectio any select upon talk hensi right is spo is w with butte sligh its e pecul sort day too blane for avoi N bird A h that will npoi brov of e In : rous mot they dist nea who out tho age han line seq but gei cha pre by the nal otł fut bir thi arı

the eyes of its enemies. To some redations. For the various individuals people it seems that so slight a pro- tend always to vary a little in marktection as this could scarcely be of ing-no two plants or animals of the any use to the butterfly. selection, they say, can hardly work but the picking off of the brightly upon such petty differences. But to co'ored individuals by, the birds helps talk so is really to show a misappre- to perserve the protected specified hension of what natural selection type intact. And of course the same rightly means. Every butterfly which causes which now preserve it originis spotted by a bird, and so devoured, ally produced it. Ever since birds is wiped out of existence for ever, and with all its possible progeny. Every process must constantly have been at butterfly which escapes, by however work; and the birds and butterflies, slight a peculiarity, is enabled to lay in the forms that we know, are the its eggs in peace, and to hand on its final outcome of its perpetual interpeculiarities to its posterity. sort of selection is going on every day around us, and no difference is imitative coloring of the under surtoo slight for it to select, no resem- face, but it does not sufficiently acblance is too clumsy provided it once for a moment aids the insect in avoiding destruction.

birds are very sharp and keen indeed. A hawk soaring so high in the sky that human sight fails to perceive it, will yet discriminate and pounce down upon a lark in the fields below - a small brown bird seated upon a brown clod in graceful curves, and seeming to be of earth exactly like itself in color. In just the same way the insectivorous birds keep a sharp look-out for moths and butterflies, upon which they swoop at once whenever they distinguish them upon the ground be-lare coquetting and flirting together, neath. whose color betrays them get thinned the best advantage, and to attract the out by their watchful enemies, while other by its own beauty. If a third those whose color protects them manage to lay their eggs in peace, and hand on their own peculiar spots and lines to their descendants. The consequence in the long run is that the butterflies get better protected from generation to generation, as the is going on forever, side by side with chances of interbreeding with badly the first; the prettiest, freshest and protected individuals are eliminated most daintily-marked insects being by the action of the birds, while only always preferred in the pairing over the most imitatively colored individ- du." r, dingier, or more battered uals are left to mate with one another and to become the parents of future swarms. birds are themselves the instruments with one another. While the butterthrough which the insects have been flies are poised motionless upon twigsarmed defensively against their dep- or flowers they are in the greatest.

Natural same species are ever exactly alikebutterflies have existed, the This | action.

This sufficiently accounts for the count for the brilliant and attractive hues of the upper side. Those hues were probably produced in a very Now, we all know that the eyes of different manner. At this exact moment I see two red admirals above the hedge yonder, engaged in their pretty rythmical courtship, flying round and round one another, now on top and now beneath, chasing each other engaged for ten minutes at a time in a sort of aerial quadrille. These two butterflies are helping in their small degree to keep up and intensify the beautiful colors of their race. They Every day those insects each eager to display all its char, s to and prettier butterfly happens to sail up, the belle will bestow her affections upon the new-comer, and the vanquished beau will slink away disgraced, leaving her to her chosen mate. This second sort of selection rivas.

It is interesting also to note how Thus the hostile the two kinds of selection run parallel

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danger from birds; but in such posi-| pressed wings, close against the tions they close their wings and dis- ground or the foliage; the other is rest suffices to keep the protective times, however, a single set of colors colors always true. On the other answers both purposes alike, as I hand, when the insects are on the have often noticed with the Jamaican wing, hovering about flowers or rising | cactus butterfly-a bright yellow inin the air to piroutte and gambol in |sect, which sits quite indistinguishable pursuers, and they seem fairly secure when it raises itself into the air on by their power of doubling as they its large and brilliant golden wings. flit rapidly along from spray to spray. The birds are bad marksmen at a moving target; they cannot double like their prey, and they prefer to aim at their butterflies sitting, as French sportsmen are said to do at partridges. On the other hand, with butterflies as with men, faint heart never won fair lady. If the insects did not venture out into the open to seek their mates and to charm them red campion in the hedgerow, hangwith their painted pinions, some ing out so temptingly that I cannot bolder rivals would carry off the refrain from picking it, and, having prize, and so leave the cowards unrep-picked it, from sitting here on the resented in future ages. Thus, in the stile between the meadows to pull it course of generations, a great many to pieces. How ineffably vast and butterflies have come to have two how hopelessly infinite is the study of sets of colors—the one set attractive | nature ! If a mere dilettante observer for their own kind, and the other set like myself—a saunterer who gathers protective against their enemies The posies and chronicles butterflies by lower sides of the wings are colored the wayside for pure love of them. like the leaves or twigs on which they were to tell even all that he has noset with folded vans; the upper sides ticed in passing of the manners and are beautifully dappled with crimson, habits of a single English weed-of orange, or metallic sheen, and flaunted lits friends and its enemies, its bidden boldly in the open sunlight as they guests and its dreaded foes, its attracflit about to woo their dainty mates. tions and its defenses, its little life-On the other hand, moths, whose history and the wider life-history of habits of folding the wings are ex- its race-he would fill a whole book actly reversed, also reverse the system up with what he knows about that of coloration. Many of them which one little neglected flower; and yet fly by day are quite as exquisitely he would have found out after all decked as any butterflies, especially but a small fraction of all that could in the tropics; but as a rule they be known about it, if all were ever have the upper surface of the pinions knowable. imitative or protective, while the un- Admirable Crichton or a Pico della der surface is bright and attractive. Mirandolo could offer to dispute de

play only the outer surface, which is turned to the insect's mates, flashing imitatively and protectively colored. in the sunshine with iridescent hues, The constant picking off of all those as they chase one another fantastically which can be distinguished when at in their airy love-making. Somethe air with their mates, they run among the yellow flowers of the comparatively little risk from the common wild cactus, while it becomes birds. They are too nimble for their a very conspicuous creature indeed Something of the same sort, on a smaller scale, may be observed with our own yellow cabbage butterflies on the golden bunches of flowering charlock in an English cornfield.

V.

RED CAMPION AGAIN.

Ecce iterum Crispinus! Another Happy days when an The one alone is seen from above, as omni scibili with every comer. In the insect sits with outspread but de- our own degenerate times one would

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hardly like to engage duly to describe the omnc scibile of a solitary little here does not consist of separate red campion. Yet the very sense of this vastness makes it ridiculous presumption for any man to dispose of the red campion altogether at a single welded together into a swollen bellsitting. I must stop to look again at shaped tube-a campanular calyx, as my pretty flower, and to decide upon the systematists call it. the meaning of at least the most tube, five large pink petals rise on salient points in its structure and ar- long claws, kept together in shape by rangement.

and of course share all the main pe- lie the pollen-bearing stamens or the culiarities of the pinks generally. ovary with its embryo seeds, each in But the habit of the family as regards a separate flower, whereof "more its method of fertilization differs anon." Thus the pollen and the greatly from plant to plant, and has honey are concealed out of sight of impressed itself markedly upon their the useless small insects, and they can forms. pinks which lays itself open to all the cis of the bee or the butterfly. To presmall flies and beetles of the world, vent ants, small beetles, and other who come and eat its pollen freely to honey-eating intruders from creeping their hearts' content. Of these, the up the stalk, and so rifling the neccommon chickweed and the white taries without doing any good to the stitchwort are familiar examples. plant in return, the stem of the cam-Most of them are petty, mean look-pion is covered with hairs, and it ing, inconspicuous, weedy plants, be-lexudes a sticky, viscid gum, both of cause they lay themselves out for which peculiarities aid it in baffling mixed small deer of uncertain and the unwelcome wingless visitors; undecided tastes, and do not attempt specially to attract the color-loving and butterflies, the æsthetic bees aristocrats of the insect world. Hence their petals are small, ragged, and as if so many precautions were not mostly white, and their calyx consists of five separate spreading pieces. They keep open house, as it were, for all comers without inquiry, displaying their pollen unprotected to whoever wants it, on the chance of a stray grain or two being carried by the insects from head to head. But the campions belong to a higher and more specialized department of the pink They and their ancestors have tribe. devoted themselves to bees, butterflies, and other developed flowerhunters, whose long proboseis is peculiarly intended to aid them in extracting the honey from deep tubular blossoms. Thus they have slowly acquired, by long selection, a structure exactly adapted to a surer and less fertilization are now actually in course wasteful mode of fertilization by of being followed up by another premeans of these higher insect allies.

The outer covering of this campion green sepuls, like those of the stitchwort, which I have picked for comparison with it; its five pieces are Within the the pressure of the calyx. Inside the The campions are pinks by family, inner passage formed by the petals There is one great group of only be reached by the long proboswhile the inflated ealyx and long tube effectually keep out all flying insects, except the few for whose visits the plants specially lays itself out. Nay, enough, the mouth of the tube, above the stamens, is furthermore obstructed by five little valves or scales, one being attached to the claw of each petal; and these scales can easily be craned over, like tiny walls, by the large and long proboscis of the bees or moths, but not by the little thieving flies against whose incursions the flowers are so anxious to guard themselves. Given the red campion, it is easy enough to evolve the white from it; but who can say. how many geological ages have gone to the evolution of that parent form itself from a single open blossom like the white stitchwort?

All these precautions for due crosscaution yet more efficacious than any.

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The head of blossom which I hold in clements in every plant or animal. in passing, consists wholly of male which must date back before the flowers; every blossom contains stam- ancestors of A diverged from the another hand, here in the hedge beside share in it; this, again, is a peculime stands another plant of the same arity which dates later than the divergkind whose blossoms are all female; ence, because A possesses it, while B every one of them contains a young capsule only, with the embryo seeds distinctly visible when I cut it open, but without a trace of stamens. This times found in A to-day, but someseparation of the fructifying elements | times it is absent." It such a manner on different plants is a very recent as this it would not be difficult innovation in the campions, and it roughly to reconstruct the whole hismarks a very high degree of differentiation-one not attained by the vast majority of the most developed plant types. The open pinks, such as chick weed, have stamens and pistils in each flower, and trust to chance for avoiding the evils of self-fertilization, Even the other campions have the same common arrangement; but the red and white campions are peculiar in the fact that they have suppressed the stamens of some flowers and the pistils of others, thus making separate individuals wholly male or wholly female. Such an arrangement of course makes cross-fertilization abso lutely certain, and gives the species a near Tom Fowler's cottage is full of great advantage in the struggle for life over its less differentiated neighbors. But the recent date of the improvement is shown by its incompleteness; for you may still find some stray campions with perfect stamens and fertile capsules in the same blossom.

Here, as in so many other cases, we catch modification in the very act. For it is a fatal habit to picture evolution to oneself as a closed chapter; we should think of it rather as a chapter that goes on writing itself continuously for ever. The white campion is even now in course of armed with pick and shovel, to uncompleting its development from the earth and carry off one of these red; and red and white together are uncanny brutes for my kitchen folk. both even new in course of transform- After a little digging in the bank, ing themselves from the hermaphro- using my pick carefully for tear of dite to the separate condition. The injuring the poor timid beast, I have naturalist can generally make a got to the round warm nest, a mere shrewd guess at the age of various hollow in the ground roughly floored

my hand, and which I have pulled off He can say, "This is a peculiarity ensonly, without any pistils. On the cestors of B, because both of them does not: and this, once more, is a peculiarity which has hardly yet established itself, because it is sometory of the red campion, if a busy world had leisure to hear it. But what centum lingua, what ferrea vox, would ever suffice to reconstruct the whole history of all the plants and animals I can see around me? It is easy enough to eatch their episodes vaguely as one examines them; but to write them all down in definite language is a task of which even science itself may well despair.

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VI.

THE HEDGEHOG'S HOLE.

The broken ground in the warren burrows of every description, from the big badger's nest by Chimney Rock to the rabbits' heles and tiny shrew-runs that honeycomb the soft mould beside the landslip. Among them are some which I know from the pattering tracks at the mouth or entrance to be the haunts of spiny hedgehogs-the long interval between the prints of fore and hind feet, and the deep toe-nail marks in the damp elay are quite unmistakable; and as we want a tame hedgehog to keep down the cockroaches in our lower premises, I have turned out to-day,

with leaves and dry moss, and lined | tinct fossil genus ceratodus was found on the top with a soft vault of the alive in the rivers of Queensland, same materials. And now the crea- thus connecting the ganoid fishes with ture lies motionless in my shovel, the transitional lepidosiren, and rolled tightly up into a prickly ball, through it with the amphibious newts, and absolutely unassailable in its frogs and salamanders. The uncon-spherical suit of shurply pointed scious black fellow used to devour as spike-armor. No defensive mail could barramunda, and the colonist used be more effectual or more deterrent. I cannot even lift him up to put him into my basket; I am obliged literally to shovel him in, and then tie down the flap to keep him safely. There I can see him now through the wattles, slowly unrolling himself, and peering about with his blinking, beady black in a ball of earth the finest surviving eyes, as if to inquire what Arabian representative of the most ancient Nights' enchantment has so strangely transferred him against his will to this him up (dead, I am glad to say) in a curious locomotive prison.

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Hedgehogs are really very common animals in England, and yet few people have any idea of their existence among half the hedges and banks in the meadows and copses around them. The little animals lie hidden in their subterranean holes or open nests during the daytime, and only come out in search of slugs, grubs and beetles at nightfall. Yet they are a precious heritage of our age for all that, for they and the few other remaining members of the old insectivorous group form the last survivors of a cupy the central position among all very early and undeveloped mammalian type, the common ancestors of among all mammals higher than the all our other European quadrupeds, who have diverged from them in various specialized directions. They rank as interesting middle links in ally are but little specialized. All that great broken but still traceable the other common quadrupeds-the chain which connects the higher mammals with their lost and unknown semi-reptilian ancestors. Indeed, if we had never heard of the hedgehogs and their allies before, and if one were now to be brought for the first time by some intrepid explorer from Central Africa or the Australian bush, all our biologists would be as delighted with it as they were when the ornithorhynchus and the echidna passed by. Time was when the anwere discovered and recognized as cestors of dogs and deer and sheep links between the reptile and the and rabbits had risen no higher in the marsupial, or when the supposed ex-'scale of life than these small-brained

quietly to pickle as salmon, a marvelous double-lived creature, provided with perfect gills and perfect lungs, for one specimen of which a naturalist would have given his right eye; and so, too, our own gipsies have been in the habit for ages of baking placental mammalian line. They roll mass of kneaded clay, which they put into the fire whole until it begins to crack; and then they turn out the steaming flesh by breaking the ball, while the skin and the spines stick in a body to the hardened lump of earth. Yet the creature which they so unceremoniously devour is actually the eldest scion of the great mammalian stock, whereof all the reigning houses in Europe are, after all, but younger branches.

The insectivores, indeed, as Professor Huxley has often pointed out, ocplacental mammals-that is to say, pouched class of opossums and kangaroos. Their brain is very small and undeveloped, and their organs genercarnivores, the rodents, the ungulates -have certain resemblances towards them which they have not towards one another. This shows that the hedgehogs, moles and shrews, our representative English insectivores, display, as it were, an arrest of development-exhibit to us an early stage of mammalian life which the other European animals have long

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VIGNETTES FROM NATURE.

the other races have, for ages, outstripped their hedgehog-like ancestors, the hedgehogs themselves have remained always at the same low level of development and intelligence. Such arrests are not uncommon. In the dim past of geological ages, we know that there must have been at some time a primitive forefather of the whole mammalian stock who had some affinities to the true reptiles and still more to the frogs. Of this hypothetical progenitor of hedgehogs and men we have now no trace; but of many subsequent stages we have traces in abundance. The ornithorhynchus and echidna, which are mammals only by courtesy, still preserve for us the intermediate step between this frog-like creature and the true quadrupeds. The kangaroos, wombats and phalangers show us a still higher link. The insectivores carry us a step further; and from them on to the highest embodiment of all the live upon the continents, and indeed great types-the cats, the elephants, the buffaloes, the horse and man--the further enabled to drag on their exstages are all easy and gradual

Why, then, do such intermediate links survive? Why have they not all developed alike? When some primitive insectivores grew into nascent carnivores and nascent ungulates, why did some still remain at the old low insectivorous stage of hedgehogs and moles? The answer is, because their organization was quite high enough to fit them for the work they had to do in life. in the world; and because they filled it they have lived on, while other types, adapted to higher functions, have outstripped them, and taken the menial or dishonored places in the upper seats in the hierarchy of ani-|commonwealth of nature, have been mal life.

important considerations to be borne in mind in endeavoring to understand the reason for the survival of such sideration which it would be impossilowly-organized groups in the pres- ble to pass by without leaving a very ence of more highly-evolved and bet- false impression as to these outcasts ter-endowed races. In the first place, of animal life. Though they all repthese straggling survivors are gener- resent low and little-developed types,

and stupid little creatures. But while far from the fierce competition of great continents or of thickly-popu-. lated districts. Thus the ornithorhynchus and the echidna, the two lowest mammals or quasi-mammals, live in Australia, long isolated from the Asiatic mainland, and with no higher animals of any sort than the kangaroos. The marsupials are similarly confined to the Australian region, with the solitary exception of the opossum. The edentates, another low and early group, including the sloths and armadilloes, belong to South America; for ages a separate island, and only lately invaded by higher types across the newly-raised isthmus of Panama. The lemurs, the lowest of the monkey tribe, are almost confined to Madagascar, as are also some other primitive forms. Among the insectivores themselves, the greater number belong to such places as Haiti, Mauritius, Java, and the Malay Archipelago generally. Those which most of the old types as a whole, are istence somehow by nocturnal, subterranean, or water-haunting habits, as well as by living upon small and innutritious food. Thus the lemurs, hedgehogs, and aye-ayes feed by night only; the ornithorhyncus, oared-shrew, and muskrat live in the rivers; the lole passes all his time underground; and the whole set alike burrow or hide away for the best part of their lives, feeding upon They filled a place insects, like the ant-eater, or upon reptiles and carrion, like the armadillo. Thus, in one way or another, these low forms, by accepting the enabled to live on, in stealth and At the same time, there are some quiet, as well as their more highlydeveloped and intelligent relatives.

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There is, however, one other conally found in out of the way places, they are yet as a rule highly special-

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ized representatives of those types. They have survived because they could fill some vacant place or other : and for that place they have become fully specialized. Thus, though the the lanes out for rabbit shooting brain, the skeleton, and the other organs of an ornithorhynchus or an echidna are lowly and poor, as judged by a general mammalian top of Musbury Hill. standard, yet their external form view from the breezy summit rewards is very much more specialized than one well for the trouble of climbing. the external form of the primi- In the foreground the furze or heather tive mammal could possibly have on the slopes is quaintly divided into been. broad duck bill, the webbed feet, the the little parallel avenues, down which burrowing and water-haunting adap- innumerable white tails of rabbits distations of the ornithorhyncus on the appear twinkling into the burrows at one hand, nor the spiny coat and cu- every step we take. Near the foot of rious digging paws of the echidna on the hill, just before reaching the valthe other. So with the insectivores, ley, an apple orchard stands thick The hedgehog represents the primi- with pinky bloom, a good promise tive insectivorous type, plus the fa-for the cider season; and the trunks, miliar sharp prickles, which exactly blown all one way by the wind, are recall those of the echidna: and, in- almost hidden from sight by the luxdeed, the tenree of Mauritius is a uriance of their lovely burden. hedgehog in an early stage of evolu- yond, again, the broad alluvial level tion, with the spines only half devel- stretches away to westward, with the oped. The mole in like manner rep-1 Axe meandering in S's through its resents the same primitive insectivo- midst; while in the distance the rusrous type, plus the peculiar powerful set ploughed fields among the meashovel hands, the hidden eye, the cov- dows on the opposite range betray ered car, and the close fur, which fit the red triassic soil of Devonshire. it so well for its underground life. It Looking along the river's course, a is just the same with the scaly armor glimpse of sea closes the vista toof the armadillo, and the long snout wards Seaton -a mere blue bay, or brush clad hind feet of the ant- hemmed in between the red cliff of eater. have only survived through a singu- taller white chalk bluffs of Beer Head lar combination of favoring circum- and Branscombe on the other. But stances -- isolated position, unusual habits, special protective armor or concealment, immense adaptation to peculiar needs. What can be more interesting than to notice the independent occurrence of the very same device of spiny mail in two creatures so unlike in structure, yet so like in habit, as the echidna and the hedgehog? But if I go on preaching in this way, I shall never carry my hedgehog home.

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VII.

ON MUSBURY CASTLE.

A STEEP pull up the hillside, through among the gorse and bracken, leads us at last to the old pre-historic earthwork or "castle" which crowns the The glorious He could not have had the formal squares of golden blossom by Be-In every case these low forms Axmouth on the one hand and the it is not wholly for the sake of the view that I have toiled up the abrupt gradient of Musbury Castle this clear May morning. Among the flinty piles of the old earthworks - once the border fortress of the Durotriges against their Damnonian foes-a little flower grows from year to year, which is found nowhere else in the neighborhood for many miles; and it is to get a few sprigs of this rare flower that I have come up here to. day, as is my yearly wont. I have just pulled it up, root and all, out of a chink in the rubble this moment; and I shall take it home in my little

my leisure hereafter, and make quite sure about some odd small points in its mode of flowering whose meaning and purpose I have not yet been able thoroughly to understand.

Meanwhile, what a curious fact it is, this regular recurrence of the same plants and animals in the same situtions from season to season! When once you have learned a little district thoroughly, it is wonderful how constant the geographical distribution of its fauna and flora always remains. In one marshy spot hereabout, and one alone, I find; summer after summer, the sundew and the bog aspho-In one lane, from time immedel. morial, the green hellebore has flowered, and nowhere else. On the cliffs to eastward, the wood pigeons always build their nest; on those to the west I have never roused a single out and disappear at once. bird. There are certain pools in the little stream which rises on the eastle as this it might at first sight seem as where a certain fixed number of smallish trout are always found; but in the branch that comes down from the green-sand opposite only stickleback and miller's thumbs are to be caught. In fact, every part of nature is a constant equilibrium : there are certain species fitted for certain places, and in those places only they exist.

This balance of life is very seldom interfered with in any way. Now and then new obtrusive species push their way in; now and then fresh varieties develop and slowly oust the older forms; but on the whole the intrieate interdependence of all parts on one another is so great that very little change ever takes place. As in the village below there is always a baker, and a butcher. and a doctor, and a parson, and a grave-digger, each fulfilling his own function, and each fruit must set and ripen its seeds; the dependent upon the rest for support, so in the broader world of plant and animal life upon the castle here there is always a fairly fixed number of how little, in any one of these parspecies and individuals, all fitting in ticulars, is utterly lost. Its chance of together into the marvelously compli- producing posterity is wholly gone cated scheme of checks and counter- from it. And the same is true of checks, of mutual services and recip- animals. The butterfly, for example,

tin case by-and-by to examine it at rocal needs. There are always just enough bees to fertilize the heather, and just enough heather to feed the bees, hedge-hogs to keep down the wire-worms, and dragon-flies to chase the gnats. In every bit of boggy ground you find boggy plants; and above them you find bog-haunting insects, on which the waterside birds perpetually prey. Wherever there is a chance for a plant or animal to make a living for itself, there you find some creature living and adapted to its place. No nook in nature is too small or inconsiderable to be oc-Countless seeds and eggs cupied. and germs are being scattered broadcast over the whole face of the earth every day and all day long, and those of them which find their fitting place live and thrive, while those of them which fall on the wrong ground die

In such a complex balance of life though no new forms could ever be evolved. Where the conditions to be complied with are so numerous, where the interaction is so all-embracing, surely it must be hard enough just to keep up the ordinary requirements of each species, without ever rising to higher and still higher complications again But if we look a little closer into the problem, we shall see that this very complexity itself produces the necessity for further advance. Every plant and every animal must succeed, not only partially, but always and all along the line. The seed must escape the attacks of birds and animals, for if it is once eaten up it can never grow to be a plant at all. The young shoot must escape the grubs and locusts; the flower must open and secure its fertilization; the seed again must be dispersed and reach its proper soil and position. Every plant which fails, no matter

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must find food as a caterpillar, and | The squirrel survives because it can must escape the eyes of birds; it must hide itself away as a chrysalis; it must make itself proof against frosts and rains; it must hit upon sunny weather in its full-fledged winged form; it must find, woo, charm, and secure its mate; it must lay its eggs on the proper plants, and in a safe position. Thus every existing individual of every species is the lescendant of countless ancestors on ach side, every one of whom must necessarily have fulfilled all the complex conditions of existence at every moment of their lives. If they had not done so, it would not be here en évidence to answer for their success.

However, as all individuals are liable to vary a little individuallyto be lighter or darker, larger or smaller, longer in this limb and shorter in that, than one another-it must follow that each individual must be slightly better or worse adapted for surviving in certain special circumstances than some other. Such petty differences are for ever being produced, and the better are constantly, on the average, living down the worse, while the worse are being constantly weeded out. If at any moment we look at the world as a whole, we see apparent balance, nay, rather temporary balance; every part fits in to every other with absolute adapta tion. But if we compare widely different times we see that the balance is always altering, that types change indefinitely from age to age. Each plant and each animal fulfills all the necessary conditions of existence every day of its life, or else ceases to exist, the survivors being always those who have succeeded in fulfilling them; but then the conditions are always slightly changing, and so the survivors, from time to time, are slightly different. Every increase of speed in the pursuer is followed by an increase of speed in the pursued, since only the the gravel lay the sharp flint knife in swiftest will now escape; every sharptoothed squirrel opens still harder and lithic hunter had scraped the bones of hardest alone to produce future trees. years ago, when the little river stilk

crack nuts which other squirrels must refuse; the nut survives because it. can baffle the squirrel which can crack so many other nuts.

VIII.

A BIG FOSSIL BONE.

The cliff to eastward of the village consists of soft blue lias strata, interspersed with harder layers of concreted limestone; and both deposits are worked by the quarrymen for different purposes. The soft sticky clay of the banded belts is used in making blue lias cement at the little mill beside the harbor-our one solitary manufacturing industry-while the intermediate hard layers are burnt for quicklime in the village kilns. This morning, a message from one of the navvies, who knows my taste for antiquities, brought me up here in hot haste from the breakfast table, for fear the rival collector should be beforehand with me in securing a splendid prize. He had found, he said, a lot of "verterberries"-that is our local word for vertebre-and also what he took to be a flint implement. One can never trust the scientific diagnosis of a quarryman, so I wasnot quite sure whether he had really hit upon a big saurian in the secondary lias, or upon some mammalian remains in the quaternary gravel which caps the cliff, and which the workmen have to clear away in the course of their excavations. Fortunately for me, it turned out to be the latter: for I do not busy myself much about "dragons," as our navvies call the great saw-toothed saurians, but I am always interested in a stone instrument, or anything else which bears directly upon the early history of mankind. The bones proved to be three fragments of a mammoth skeleton; and close beside them in situ, with which perhaps some palæoharder nuts, and thus leaves the very his huge prey a hundred thousand

ust er, the the ase gy ind inrds e is to you ted e is 00ggs)adırth 1080 lace nem die life n as r be s to ous, racugh iireever ombk a hall tself adimal but The irds n up : all. the nust the the and tion. tter pare of one e of iple, flowed at this higher level, thirty yards above the bed of its existing channel. I have pocketed the flint are on the whole not only quite as after a little commercial transaction with the navyy offhand: and now I am mounting guard over the mammoth bones, waiting till a relay of workmen arrives from the village below to dig them all out for me carefully as they stand.

It is common enough to near visitors at a geological museum say to one another, "Ah, everything used to be so much bigger in those days" -the exact period to which they thus refer being no doubt the cosmical equivalent of that familiar historical epoch, the olden time. Looking about them at the big fossils which form the most striking features of the exhibition, they picture to themselves a world where the sea swarmed with gigantic enaliosaurians and huge cetaceans, where the land was covered with deinotheria and mastodons, where all the birds were moas, all the lizards were crocodiles, and all the snails were monstrous ammonites. Everywhere they seem to find in fossil forms a bigger animal of each kind than any now existing. They see here an enormous Irish elk, there an immense extinct sloth, vonder a vast prototype of the little modern armadillo, and somewhere else a turtle ten times as big as the greatest living member of the tortoise group. They fact, there are only two important forget that the huge saurians were groups, the birds and the reptiles, in secondary animals, while the deinotherium was tertiary, the mammoth larger than existing ones; and in quaternary, and the moa all but modern. They forget that the age of the great ammonites was almost the mammalian type. over before the age of the great lizards set in. They forget that the glyptodon lived in South America, while the big elk lived in Ireland. By that kind of false historical perspective which throws all the distant past into a single line, they roll together millions and millions of years; and so they get a distorted geological picture, which really quite the moa and the dodo-have only reverses the actual facts as to the relative size of animals in the past and like the Irish elk and the mammoth, the present.

As a matter of fact it seems probable that our actual fauna and flora big as any previous ones, but even a great deal bigger. If we take single instances, no known extinct animal was as large as some of our modern whales: if we look at the ensemble of our existing species, no known period comprised so many large forms as we can show at the present day in our three or four great cetaceans, our two elephants, our hippopotamus, our rhinoceros, our bisons, our giraffe, our walrus, and our horses. These would probably form a total assemblage of larger average size than any previous epoch could produce. Similarly, in almost every special class, we could apparently show larger species at the present day than any which we know to have existed in fossil forms. Our whale is the biggest known mammal; our gigantic salamander is the biggest known amphibian; probably our sunfish, our tunnies, our sharks, and our devil fish are each in their way larger than almost any previous fishes—one living shark actually attaining a length of forty feet. No fossil bivalve molluses to my knowledge are as big as the common Mediterranean pinna, or as that giant clam, the tridacna, whose shell is so commonly used as a basin for fountains. հո which extinct species were much these two groups the decrease is evidently due to the later supremacy of

Similarly, if we take many comparatively modern lines of descent, we shall find that the horses, the deer, the elephants, and several other now dominant groups of animals have been steadily increasing in size from the earliest epoch of their appearance te the recent period. And among the great extinct creatures, some-like quite recently been killed off; others, belong to the very latest geological representatives nearly, if not quite, as big as themselves. The teeth of known fish—a prodigious shark—are dredged up among the modern ooze of the Pacific; and though no individuals quite large enough to have owned them have ever been observed, yet may well expect one to turn up in the flesh at some future period, while even more skeptical persons must still admit that they have become extinct at a very late date.

The explanation of the existence and extinction of extremely large animals in each group seems to be this. As a whole, evolution appears to tend towards an increase of size in some members, at least, of every But this increase is most noclass. ticeable among members of what is, for the time being, the dominant elass; and, when another class outstrips it in development, the new dominant kinds are apt to live down the bigger species among their pre-decessors. Thus, in the very earliest times, the mollusks were apparently the dominant class; and very big cuttle fish and other cephalopods were frequent—though none of them, perhaps, were quite so big as our own gigantic squids. At a later date the reptiles were developed, and grew to be the leading race on earth; and during that period the bigger saurians attained to extremely large dimensions. Ever since the opening of the tertiary period, however, the mammals have become the forefront of the animal series, and big mammals have everywhere replaced big reptiles. But there were some few insulated spots where mammals did not penetrate for a long time, and here birds were the leading class. In such cases terrestrial birds grew to be very large, indeed.

now existing upon earth. In the Asia in the east, North America in

period; and yet others, though of great continents they are almost all somewhat higher antiquity, like the dominant mammals; for example, the animals of the Paris basin, have left elephant, rhinoceros, hippopotamus, giraffe and bison. Wherever we get large species of lower mammals or of what seems to have been the biggest the inferior classes, they are invariably found either on insulated lands or on lands but recently united to the continents. Thus, the great fossil sloths, armadillos, and other edentates belong to the insular fauna of people who believe in the sea-serpent South America, where no higher mammals existed; as soon as the mammalian types of the northern continent began to make thei way across the quite modern Isthmus of Panama, all the bigger native forms became extinet. Just in the same way, Australia still possesses a very large marsupial in the great kangaroo; but if the Australian region had ever been joined to Asia, the Asiatie carnivores would soon have exterminated this stupid and defenseless herbivore. So, too, the moa was developed in New Zealand, where there were no mammals at all, and where the apteryx is still the highest native animal, now that the moa has been exterminated by man. In like manner, the ostriches and rheas, the cassowaries and emus, and all the other big struthious birds belong either to the islands of the Australian and Malay group, where they have but little mammalian competition, and that of a low grade, or to South Africa and South America, both of which were long equally insulated, and where most of the fanna is still of a very inferior type. Similarly with reptiles: the big saurians are all dead, except in the case of the crocodiles and alligators, which haunt fresh waters alone; and fresh waters, we know, are almost as insular in their way as islands themselves. The Galapagos Archipelago has for its highest inhabitant a monstrous lizard. Among amphibians again, the gigantic salamander belongs to Japan.

On the other hand, the two great On this simple principle we can ac- continents which developed the highcount for almost all the big creatures er mammalian fauna-Europe and

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no very large terrestrial reptiles, no very large amphibians; and their lower mammals are all small and skulking species-mere rats, hedgehogs, shrews, and moles, instead of big sloths, kangaroos, or megatheria. In the oceans, where mammals are at of the sky above. It was the vera some disadvantage, and where they have not yet firmly established themselves, big fish still abound. Nevertheless, ven here, the whales, porpoises, walruses, seals, manatees, and other aquatic mammals are pushing them hard; and we know that the sharks and rays, the monsters of their kind, as well as many other big tribes of fish, are now in their decadence. Thus it would seem that everywhere ten too largely interwoven with hard some animals of the dominant types are the largest, and that mammals, therefore, now tend all over the world to replace the large members of inferior groups.

IX.

VERONICA.

This pretty little blue flower, growing so abundantly beside the footpath, is called in English speedwell, and in botanical Latin veronica. Thereby hangs a sufficiently pretty legendary logical Gradgrind, still spelling away tale. Everybody knows how the napkin with which a compassionate maiden wiped the face of Christ on the of skimming the great book of nature morning of the crucifixion bore ever easily through, with a free glance after the imprint of the divine fea- from end to end. Surely there are tures. preserved as the one genuine picture | are dreamt of in Gradgrind's philosoof Our Lord was known in a mongrel Greek and Latin phrase as the vera icon, the true eikôn or image of the of the veronica. Even if the Gradmartyred Saviour. By a natural transposition of sound and sense, the and it is clearly the business of science unknown maiden was popularly canonized as St Veronica, just as the and Gradgrind, as well as to explain real blood of Christ, the Sangre Real or Sang Réel, preserved by Joseph of |all. Arimathea, became the Saint Gréal sidedness which the real man of and the Holy Grail of mediæval le- science will do well to avoid. Thorgends. At some later period, by a eau, who loved nature as few men pretty conceit, some poetical botanist have loved it, nevertheless sneered at

the west-have no very large birds, though I don't know whether he invented the name himself or only borrowed it from the early herbaliststransferred the title of veronica to this lovely little blue blossom, because it seemed to him exactly to mirror in its delicate hue the deep azure color icon of the open heaven, and so he called it, too, veronica. The conceit is far-fetched, no doubt; but it is a pleasant one to me; and I can never see the first speedwells opening their familiar blue flowers in the springtime without feeling that the legend throws an added charm for my mind around their simple native prettiness.

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Our thoughts about nature are oftechnicalities concerning rotate corollas and pedicellate racemes; and I for my part am not ashamed to confess that I like sometimes to see the dry light of science diversified with some more fallacious scintillations of the literce humaniores or even with some will-o'-the-wisp of pure poetical imagination. After all, these things too are themselves matter for the highest science; and that kind of scientific man who cannot recognize their use and interest is himself as yet but a one-sided creature, a chemical or bioblunderingly at the weak and beggarly elements of knowledge, instead. The miraculous portrait thus more things in heaven and earth than phy

For example, there is the beauty grinds do not see it, you and I do; to explain this difference between us why we have the sense of beauty at There are two kinds of oneor other-I think it was Tournefort, 'geology as a lot of old broken shells:

he iny borlistsica to ecause rror in color vera so he onceit it is a never their pringlegend 7 mind tiness. are ofi hard corold I for confess he dry some of the h some imaggs too lighest entific eir use but a or bioaway l begnstead. nature glance re are h than iloso-

eauty Grad-I do; cience en us cplain ity at onein of Thormen red at hells:

that was the one-sidedness of the po-arboreal ancestors, who themselves etical and artistic temperament. He sought their food among bright orthought he was showing his own su-lange and blue and crimson fruits in periority of mind, when he was really tropical forests : and those fruits were showing only his narrowness of view. On the other hand, Gradgrind and just is the speedwells and primroses Dryasdust sneer at the beauty of the and outtercups are specially colored veronica; that is the one-sidedness of the practical, technical, and scientific The true man of temperament. science will reconcile the two. He will see no incompatibility between loving the birds and beasts as well as Thorean, and yet taking an interest in the old broken shells as well as Lyell or Murchison; between knowing all about the conduplicate cotyledons with Dryasdust, and admiring the autumn fields with Millet or with Ruskin. The two stamens and the united petals of the veronica are facts which demand explanation in one way; the blue color and the touching prettiness of the same veronica are facts which equally demand explanation in another way: and I for my part can see no reason why the one set of facts should not be just as worthy of scientific examination as the other.

Luckily for us, we have now at last got a philosophy of life which enables ns, as it seems to me, to explain both on very similar principles. The tubular shape of the speedwell's corolla and the irregularity of its stamens, as well as the peculiar one-sidedness of a strongly developed instinct inherited its petals, are all due to the necessities from the lower animals"? Oh no, of its fertilization by insects. In that surely far otherwise. way, and in no other, it secures the so learned Darwin and Spencer. As safe deposit of its pollen on the head just now I read the writer's words, of the bee or the beetle, and its further lying here in the sunshine on the safe conveyance to the pistil of some bank, I picked this blue speedwell, neighboring blossom. For just the and gazed closely at it, and I saw desame reason it has bright blue petals nial looking at me from every line on to attract the eyes of the insect; and its face. We might as well say that those petals are streaked with dainty the artistic sense of a Burne Jones or darker or lighter lines, which guide a Rosetti was a survival from the arthe friendly visitor straight to the tistic sense of the cave-men who honey-glands. That, put briefly, is etched reindeers in the Périgord grot-why the veronica is blue and deli- toes, or that the mechanical genius of cately veined.

col rs, meant to attract the insect, as chipped flints ages ago besides the pretty, seems to me equally obvious. Somme at St. Acheul. Darwinism We are the descendants of ancient does not degrade our race-it elevates

specially colored to allure their eyes, to allure the eyes of bee or butterfly. And further, as the eyes of the bees are so developed that these colors attract them, the eyes of our pre-human ancestors must have been so developed as to be attracted by the similar colors of oranges and mangoes, and tertiary plums or peaches. Flowers and fruits alike depend upon animals for fertilization or dispersion; and alike possess the same enticements of sweet juices, fragrant scents, and bright colors. Hence it seems natural to conclude that the senses of animals have been evolved in strict correlation with such stimulants, and that the thrill of pleasure which we now derive from beautiful colors is in some degree a vague and persistent echo of feelings long since experienced by our frugivorous ancestors.

And shall we therefore say with the writer in last week's Nature, which I have brought out in my pocket, "We are landed at the rather humiliating conclusion that a sense of the beautiful, and an admiration for the forms and colors of nature, is only We have not a Watt or an Edison was an instinct The reason why we consider these inherited from the black fellows who it. the rise of man; for a hopelessly de- primitive instinct of our semi-human graded lapse from an imaginary Par- progenitors. Do not let us shut our adise in the past it substitutes a hopeful progress towards a perfectible and ary facts disclosed by biology; but realizable Paradise in the future.

The love for the blue color in the veronica is doubtless due in its inception to the primitive love for color is none the less man because we becommon to all frugivorous races. But it is not only that. If it were a mere survival it would be weaker in us than in the monkeys; whereas it is, as a matter of fact, infinitely stronger, We all of us-yes, including even Gradgrind himself-love the little blue veronica with a love of which no lower animal is capable. We have gone on increasing and widening our love for color-we have copse this bright breezy summer evenemployed it first for personal decoration, in flowers, feathers, gems, and pigments; then for the decoration of our houses and belongings; then for the bourne, I have not only gathered painting proper and true art. Thus a thick handful of those quaint greenat last the mere beauty of color by tipped spiky flowers themselves, but itself, apart from other emotional as- have also lighted unexpectedly upon sociations, has become far more the first full-blown guelder rose of the potent with us, and especially with season. The bush hangs out of the civilized man, than with our early hedge which severs the copse from progenitors or with our four-handed the Four Acre; and my eye was atcousins. We can admire sunsets and tracted a hundred yards off by the sunrises at which they would gaze in great bunches of snow-white blossom, stolid indifference. We can admire drooping in massive trusses from the autumn lues, and distant hills, and long sprays that outgrow the shorter countless effects of cloud or light on and stiffer branches of the over-blown sea and sky and landscape. And to hawthorns. Guelder roses are by no all these we add a thousand higher means rare flowers, yet I always like elements of the sense of beauty. We to pick a piece or two, because of the feel at once that the speedwell has curious peculiarity which causes them symmetry of a b autiful sort, which to be cultivated so much in our shrubwe have learned to appreciate more beries. Not that this real woodland than any other creatures in the slow bush-flower has any close resemblance growth of human products, from the to the round balls of distorted blosstone hatchet to Brussels lace and soms that our gardeners and florists Henry II. pottery, from the circular have been at so much pains to prohut to Salisbury and Chartres. We duce for the delectation of tasteless feel, also, the beauty of its home as patrons. In this its native state the sociations, of its connected legendary guelder rose has a bunch of small lore, of its old English name, of its white, or rather cream-colored flowers, domestic familiarity. reflection upon it of much poetical those of the elder; and, indeed, the fancy and dainty conceit. All these very name is said to be a mere philothings go to make up our sense of logical blunder for elder-rose, and

For the full of man it substitutes, just as much as the blue color and the eyes, like Mr. Ruskin, to the elementdo not let us, on the other hand, try to resolve our whole complex nature into quadrumanous elements. Man lieve that his very remote ancestor was a sort of distant cousin to the gorilla. We to-day are none the more gorillas for all that.

X.

GUELDER ROSE.

Coming out here into the alder ing, in search of the sweet-scented butterfly orchids which grow 80 abundantly in the marshy spots beside We feel the for the most part a good deal like beauty when we look at a speedwell, to have no real connection with

Guelderland in any way. more closely do the little creamcolored flowers resemble the blossoms of the wayfaring tree, a member of the same genns, whose mealy leaves and little blue-black berries are familiar objects towards the close of autumn in every tangled overgrown The guelder rose differs, hedge-row. however, from the wayfaring tree in one conspicuous particular. It has a row of large snow-white flowers on the outside of each bunch, at least twenty times as big as the central ones. They look almost as if they were the blossoms of some other and larger plant, deftly arranged or pinned by some mischievous boy around a bunch as greatly to increase the total conof elder blossom, so as to hoax the unwary botanist with a cunning deception. But they are real component elements of the flower-head for all that; and it is these self-same odd, overgrown outer flowers which make the guelder rose so interesting a plant in the eyes of the evolutionary hiologist.

Looking close at the small central florets, one can see at a glance that each has a little tubular corolla of five united petals, with stamens and pistil in the center, enclosing the germ of a future berry. But the big expanded outer blossoms are built on quite a different plan. They consist entirely of a large flattened corolla with four or five round-edged lobes, milk-white instead of cream-colored, and measuring near an inch across, instead of being hardly larger than a barleycorn. Moreover, most significant of all, they have no stamens, no pistil, and no ovary containing an embryo fruit. They are barren blossoms, without any other object in life than that of bare display. What, then, is the good of them ?

Well, their purpose is, no doubt, to add extra attractiveness to the bunches of which they form part. All plants that depend upon insects carry the process one step further; for their fertilization are compelled to for they artificially select such gueldmake a great show in order to lure er roses as have the largest number the insects into paying them proper of barren flowers in each head, until attention. In the guelder rose a few at last they produce a carefully culti-

Still outer flowers of each bunch are sacrificed to this particular purpose. They are specialized for the function of attraction, as the philosophical botanists would say. This is, indeed, a phenomenon which occurs often enough in many plants, though in few so conspicnously as in the guelder rose. In daisies and sunflowers, the outer florets of each head have their petals prolonged into pink-tipped or golden rays, which give the compound bunch much the appearance of a single blossom. In cow-parsnip and most other umbellates, the two outer petals of all the external flowers grow much bigger than their three inner petals, so spicuousness of the whole bunch. Whenever the separate blossoms of a plant have grown so small as to beindividually little attractive, they will clearly gain an advantage by detailing some of their number to do special duty as advertisements. But it seems difficult at first sight to see how natural selection can bring about such a result. Mr. Herbert Spencer has pointed out the way out of this difficulty.

> If you look at a cow-parsnip, you will see that the crowded central flowers of each head are very small, with cramped petais, because they have no room to expand without crushing oneanother; but the freer external flowers are much larger, with broader petals, especially on the outer edge, because they have plenty of room in which to spread, and plenty of light and air on which to feed. Thus, in all crowded trusses of blossom, the outer flowers tend as a rule to grow larger and more showy than the inner ones; and if this natural tendency happens to aid the plant by giving it. an extra chance of insect fertilization. it will be increased and specialized by constant selection of those individuals. which best display it. Our gardeners.

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VIGNETTES FROM NATURE.

vated monstrosity with all the flowers to produce a great number of them, barren and broad-petalled, so as to in order to sceure a fair chance that form a great white fluffy ball. Such one at least shall fall upon a fitting a monstrous variety could never be spot for its germination. perpetuated in a state of nature, be-some plants the seed-covering grows cause it produces no seed: it can only soft and succulent, becoming what in be propagated by slips and enttings, ordinary parlance we call a fruit or But our florists are fond of these dis- berry. irrespective of use to the plant. So hard seed in circumstances admirably in double daisies they turn the inner adapted for its growth. Plants of fertile flowers into barren rays; in this sort, therefore, lay themselves the dahlia they cultivate out the cen- out to allure the dispersing birds, tral florets, and make the others mere and accordingly fill their fruits with useless tubular blossoms; and in roses sweet juices and bright coloring, just they degrade the stamens into shape- as they render their flowers attractive less and supernumerary petals. Such with honey and surround them with artificial flowers are never beautiful brilliant petals to allure the fertilizing to a botanical eye, because they lack insects. symmetry and order. When once you now produce much more than one have learnt to understand and admire seed in each fruit, because the seeds the simple and effective plan upon have so much a better chance of which all flower architecture is based, growing up than they used to have. these distorted and monstrous blos- Hence most berries contain very few soms have no more attraction for seeds, often only one, and in many your eye than the calf with five legs cases the numerous cells of the dry or the two-headed nighting ale has for an estral capsule get aborted in an any cultivated taste.

the guelder rose. If I cut open one fruit. Almost all the honeysuckle of the very young flower-buds, and tribe (to which, though you would look at it carefully with my powerful hardly think it, the guelder rose be-Wittle pocket lens, I can see that in longs) have succulent fruits; and this early stage it has three cells in their seeds are solitary, or at least the undeveloped fruit, whereas the very few in each cell. So that the ripe berry has only one, with a single three cells of these very young flowseed. Even in the full-blown flowers here two of the cells have atrophied, though there are still three little stigmas or sensitive surfaces for the pollen, as though the plant did not know seeds in a three-celled capsule. its own mind, and rather expected to have three seeds in each berry, in- connected with this bush which one stead of one. This curious indecision can hardly afford to overlook. is doubtless due to a certain historical first is that while the flowers are fact in the ancestry of the guelder white, the berries are blackish-red, rose. Once upon a time, no doubt, and those of the nearly allied waythe progenitors of the guelder rose faring tree are dark purple. had small dry capsules instead of white is a common color for flowers, berries, with a number of seeds in but very rare in fruits; while black each cell. Such a plant as the red or dark blue and purple are common campion still retains this habit; and, colors for fruits, but very rare in therefore, as the seeds merely fall out flowers. The plant is obliged to use

But in Then a bird swallows the to produce a mass of colored surface, the pulpy covering, and rejects the Moreover, they need not early stage, because they are no Here is another curious point about longer needed by the juicy modern ers keep up the memory of a time when the guelder rose had not as yet acquired its berry, but was obliged to produce large numbers of small dry

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There are two more small matters The Now, doose upon the ground, it is necessary one set of hues to attract the proper proper birds; for we now know that angling for minnows. The heron is each species of insect and of bird has a somewhat rare bird among the a very decided taste of its own in the more cultivated parts of England; matter of chromatics. The second but just hereabouts we get a sight of point is this: the leaves of the guelder one not infrequently, for they still rose have a number of small swollen breed in a few tall ash trees at Chilglands all along the stalk, and a fringe combe Park, where the lords of the of ragged-looking leaf-like appendages | manor in mediæval times long prewhere they join the branch. These served a regular heronry to provide are very marked and obviously useful sport for their hawking. There is no structures: what is their meaning? English bird, not even the swan, so That I do not know. I merely mention them because their object seems the heron. I am leaning now breathat present insoluble. One might say less and noiseless against the gate, the same thing about a hundred other taking a good look at him, as he points in every plant or animal one stands half-knee deep on the oozy picks up in a country stroll. The descriptions of naturalists are apt to make one suppose that we know all eye fixed eagerly upon the fish below. about them. In reality, only a few Though I am still twenty yards from small parts of their mechanism are yet even partially understood. The legs, I can see distinctly his long very idea of explaining the origin of organic structure genetically is still a novel one. We have only just begun falling loosely backward over the ashto dig at the vast mine; and all we grey neck, and even the bright red can do as yet is to unearth a solitary little nugget or two and parade them feathered thighs. I dare hardly move The labor of the before the world. old-fashioned naturalists has collected beautiful plumage; and still I will an enormous mass of facts as to form try. I push very quietly through the and structure; but as to use and func- gate, but not quite quietly enough for tion we have still almost all the work the heron. to do.

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XI.

THE HERON'S HAUNT.

Most of the fields on the country side are now laid up for hay, or down in tall haulming corn; and so I am driven from my accustomed botanizing grounds on the open and compelled to take refuge in the wild bosky moorland back of Hole Common. Here, on the edge of the copse, the river widens to a considerable pool, and coming upon it softly the cranes, the bitterns, the snipes, through the wood from behind-the and the plovers-are almost necesboggy, moss-covered ground masking sarily, by the very nature of their and muffling my footfall-I have sur- typical conformation, beautiful and prised a great, graceful ash-and-white graceful in form. Their tall, slender heron, standing all unconscious on the legs, which they require for wading,

insects, and another set to attract the shallow bottom, in the very act of perfectly and absolutely graceful as bottom, with his long neck arched over the water, and his keen, purple where he poises lightly on his stilted pendant snow-white breast feathers, his crest of waving black plumes, skin of his bare legs just below the nearer to get a closer view of his One moment he raises his curved neck and poises his head a little on one side to listen for the direction of the rustling: then he catches a glimpse of me as I try to draw back silently behind a clump of flags and nettles; and in a moment his long legs give him a good spring from the bottom, his big wings spread with a suddeu flap skywards, and almost before I can note what is happening he is off and away to leeward, making in a bee-line for the high trees that fringe the artificial water in Chilcombe Hollow.

All these wading birds-the herons,

their comparatively light and well-(ciated with all our deepest emotions, poised bodies, their long, curved, so that Mirauda falling in love at first quickly-darting necks and sharp sight with Ferdinand is not a mere beaks, which they need in order to poetical fiction, but the true illustrasecure their rapid swimming prey—|tion of a psychological fact? all these things make the waders, all as on each of our minds and brains most in spite of themselves, handsome the picture of the beautiful human and shapely birds. Their feet, it is figure is, as it were, antecedently entrue, are generally rather large and graved, may not the ancestral type sprawling, with long, widespread be similarly engraved on the minds toes, so as to distribute their weight and brains of the wading birds? If on the snow-shoe principle, and prevent them from sinking in the deep soft mud on which they tread; but then we seldom see the feet, because and of taste, a graceful form with the birds, when we eatch a close view of them at all, are almost always either on stilts in the water, or flying with their legs tucked behind them, after their pretty rudder like fashion. I have often wondered whether it is this general beauty of form in the waders which has turned their æsthetic tastes, apparently, into such a sculpturesque line. Certainly, it is ideal specific gracefulness of the wadvery among this particular order of birds we get clear evidence of ornamental storks, and marabous may have acdevices, such as Mr. Darwin sets quired their very distinct and noticedown to long-exerted selective preferences in the choice of mates, the ornaments are almost always those of eaters, especially in the tropics, are form rather than those of color.

The waders, I sometimes fancy, only care for beauty of shape, not for ened in their daily search for food beauty of tint. As I stood looking among the beautiful blossoms and at the heron here just now, the same brilliant fruits of southern woodlands. old idea seemed to force itself more Thus the humming-birds, the sunclearly than ever upon my mind. The birds, and the brush-tongued lories, decorative tufted crest on the head, the pendent so far as descent is concerned, all silvery gorget on the neck, the long alike feed upon the honey and the inornamental quills of the pinions-all seets which they extract from the look exactly as if they were deliber-large tubular bells of tropical flowers; ately intended to emphasize and and all alike are noticeable for their heighten the natural gracefulness of intense metallic lustre or pure tones the heron's form. May it not be, I of color. Again, the parrots, the ask myself, that these birds, seeing toucans, the birds of paradise, and one another's staturesque shape from many other of the more beautiful generation to generation, have that exotic species, are fruit-eaters, and shape just hereditarily implanted reflect their inherited tastes in their upon the nervous system of the spe-|own gaudy plumage. But the waders cies, in connection with all their have no such special reasons for acideas of mating and of love, just as | quiring a love for bright hues. Hence

And so, would it not be natural to conclude that these birds, having thus a very graceful form as their generic standlittle richness of coloring, would naturally choose as the loveliest among their mates, not those which showed any tendency to more brighthued plumage (which indeed might be fatal to their safety, by betraying them to their enemies, the falcons and eagles), but those which most fully embodied and carried furthest the noteworthy, that wherever ing type? In some such way, it seems to me, the herons, and cranes, and able crests or lappets.

Forestine flower-feeders and fruitalmost always brightly colored. Their chromatic taste seems to get quickadjuncts-the curving three very dissimilar groups of birds the human form is hereditarily asso- their testhetic feeling seems rather to ha de foi biı of ba աթ bi co m ha lea ea in re of ha \mathbf{fr} th ve an gr m æs cr pa ad ar rie th pr fo m ve ce of SU SI aı 01 ce li tl fie lo ai tl h 0 0 ti b f

development of their own graceful going waders, represented by the forms birds have a certain natural elegance of them has a single patch of bright of shape which supplies a primitive color, a single ornamental plume, basis for æsthetic selection to work crest, or lappet. Close-fitting, inconupon. birds in early times were less brightly characteristic. colored and less decorated than their modern descendants. He might also have added that the most central and least specialized modern members of oped by natural selection longer legs each great group are similarly want- and necks and more specially adapted ing in ornamental adjuncts. They feet and beaks. Some of them are represent the earliest surviving forms | even web-footed and others boatof those into which the original type | billed. These larger, better develhas split up; they have departed least oped and more dominant birds are from the primitive organization of generally distinguished by asthetic the class to which they belong. Con-|decoration. Wherever a chance vaversely, the most highly developed riation ran in the direction of heightand specialized members of each ening and intensifying the natural group are those among which we grace of form which is implied in most often find extremely marked their specialized wading adaptations, æsthetic decoration. creatures of every class can afford to by selective preference. Hardly a pay most attention to beauty; the less single dominant wader is devoid of advanced and more skulking kinds some marked decorative adjuncts, are glad enough to eke out a preca- which set off and interpret the native rious livelihood for themselves as best utilitarian beauty of his slender figthey may, and so run rather towards ure. In many cases, as in that of protective coloring and unobtrusive the ruff (whose name sufficiently deforms than towards conspicuous ornamentation.

very fully exemplified. The most central and least specially developed each generation securing themselves of the group are its smaller members, such as the plover, the woodcock, the snipe, and the sandpipers, all of which tiously displayed before the hens durare only half-developed waders, with-ling the pairing season, and in some out the full characteristic structure or cases are produced at that time alone. correlated habits of the class. They But as to bright color, only a few live by the side of small streams; outlying southern waders, like the they roam a good deal on land in the ibis and the flamingo, living among fields; and they have only moderately the big water-lilies and marsh-flowlong legs and necks. Moreover, they ers of African valleys, ever have a are colored protectively to resemble trace of it; and even these few cases the dry grass or sand on which they cannot compare in variety or rich-hop about, and so to deceive the eyes ness of hue with the typical fruitof hawks. Many of them are more eaters and flower-feeders. or less nocturnal, and all of them are timid, skulking birds. They seem to be half-way, so to speak, on the road from the central undifferentiated group of birds, represented by the

have taken a turn towards the further larks and sparrows, to the thorough-Even the plainest wading storks, cranes, and herons. Not one Mr. Darwin has shown that spicuous plumage is their common

On the other hand, those waders which have taken to a thoroughly wading life have consequently devel-The dominant it was seized upon and perpetuated scribes his ornamental character), these decorated birds are polyga-Among the waders this principle is mous-which of course allows of only the very handsomest males in a harem. The decorative crests and plumes are always fully and ostenta-

XII.

A BED OF NETTLES.

REACHING my hand into the hedge-

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row to pick a long, lithe, blossoming | any individuals among such species spray of black bryony-here it is, with its graceful climbing stem, its glossy, heart-shaped leaves and its pretty greenish lily flowers-I have stung myself rather badly against the nettles that grow rank and tall from the rich mud in the ditch below. Nothing soothes a nettle sting like philosophy and dock-leaf; so I shall rub a little of the leaf on my hand and then sit awhile on the Hole Farm gate here to philosophize about nettles and things generally, as is my humble wont. There is a great deal more in nettles, I believe, than most people are apt to imagine; indeed, the nettle-philosophy at present current with the larger part of the world seems to me lamentably onesided. As a rule, the sting is the only point in the whole organization of the family over which we ever waste a single thought. That is our ordinary human narrowness; in each plant or animal we interest ourselves about that one part alone which has special reference to our own relations with it, for good or for evil. In a strawberry, we think only of the fruit; in a hawthorn, of the flowers; in a deadly nightshade, of the poisonous berry; and in a neitle, of the sting. Now, I frankly admit at the present moment that the nettle sting has an obtrusive and unnecessarily pungent way of forcing itself upon the human attention; but it does not sum up the whole life-history of the plant in its own one peculiarity for all that. The nettle exists for its own sake, we may be sure, and not merely for the sake of occasionally inflicting a passing smart upon the meddlesome human fingers.

However, the sting itself, viewed philosophically, is not without decided interest of its own. It is one, and perhaps the most highly developed, among the devices by which plants guard themselves against the attacks of animals. Weeds or shrubs with juicy, tender leaves are very apt to be eaten down by rabbits, cows, don-

happen to show any tendency to the development of any unpleasant habit, which prevents the herbivores from eating them, then those particular individuals will of course be spared when their neighbors are eaten, and will establish a new and specially protected variety in the course of successive generations. It does not matter what the peculiarity may be, provided only it in any way deters animals from eating the plant. In the arum, a violently acrid juice is secreted in the leaves, so as to burn the mouth of the aggressor. In the dandelion and wild lettuces, the juice is merely bitter. In houndstongue and catmint it has a nauseous taste. Then again, in the hawthorn and the blackthorn, some of the shorter branches have developed into stout, sharp spines, which tear the skin of would-be assailants. In the brambles, the hairs on the stem have thickened into pointed prickles, which answer the same purpose as the spines of their neighbors. In the thistles, the gorse and the holly, once more it is, the angles of the leaves themselves, which have grown into needle-like points, so as to deter animals from browsing upon them. But the nettle probably carries the same tendency to the furthest possible limit. Not content with mere defense, it is to some extent actively aggressive. The hairs which clothe it have become filled with a poisonous, irritating juice, and when any herbivore thrusts his tender nose into the midst of a clump, the sharp points pierce his naked skin, the liquid gets into his veins in the very neighborhood of the most sensitive nerves, and the poor creature receives at once a life-long warning against attacking nettles in future.

The way in which so curious a device has grown up is not, it seems to me, very difficult to guess. Many plants are armed with small sharp hairs, which act as a protection to them against the incursions of ants and other destructive insects. These keys and other herbivores. But if hairs are often enough more or less

liable to contain various waste products of the plant. Suppose one of vation; and it has adapted its stem these waste products in the ancestors and leaves to the station in life where of the nettle to be at first slightly it has pleased Providence to place it. pungent, by accident, as it were, then | Plants like the dock, the burdock, and it would exercise a slightly deterrent effect upon nettle-eating animals. The more stinging it grew, the more effectual would the protection be; and as in each generation the least protected plants would get eaten down, while the more protected were spared, the tendency would be for the juice to grow more and more stinging | hedgerow plants, like cleavers, chertill at last it reached the present high point of development. It is notice. able, too, that in our warrens and wild places, most of the plants are thus more or less protected in one way or another from the attacks of | animals. These neglected spots are overgrown with gorse, brambles, nettles, blackthorn, and mullein, as well as with the bitter spurges, and the stringy inedible bracken. So, too, while in our meadows we purposely propagate tender fodder plants, like grasses and clovers, we find on the margins of our pastures and by our roadsides only protected species, such as thistles, houndstongue, euckoopint, charlock, nettles (once more), and thorn bushes. The cattle or the rabbits eat down at once all juicy and succulent plants, leaving only these nauseous or prickly kinds, together extract from the air all the carbon with such stringy and innutritious they need for their growth, without weeds as chervil, plantain, and burdock. Here we see the mechanism supply (for it must always be borne of natural selection at work under our very eyes.

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But the sting certainly does not exhaust the whole philosophy of the Look, for example, at the nettle. stem and leaves. The nettle has cordingly, this type of leaf is very found its chance in life, its one fitting common among all those plants which vacancy, among the ditches and waste-places by roadsides or near cot- the same erect shrubby manner as the tages; and it has laid itself out for the circumstances in which it lives. in the dead-nettle and the hemp-nettle, Its near relative, the hop, is a twisting which are plants of a totally distinct climber; it southern cousins, the fig family, with flowers of the sage and and the mulberry, are tall and spread- rosemary type; and it is more or less ing trees. But the nextle has made simulated by ten or twenty other

glandular in structure, and therefore itself a niche in nature along the bare patches which diversify human cultithe rhubarb, which lift their leaves straight above the ground, from large subterranean revervoirs of material, have usually big, broad, undivided leaves, that overshadow all beneath them, and push boldly out on every side to drink in the air and the sunlight. On the other hand, regular vil, herb-Robert, milfoil, and most ferns, which grow in the tangled shady undermath of the banks and thickets, have usually slender, bladelike, much-divided leaves, all split up into little long narrow pushing segments, because they cannot get sunlight and air enough to build up a single large respectable rounded leaf.

> The nettle is just half-way between tnese fwo extremes. It does not grow out broad and solitary like the burdock, nor does it creep under the hedges like the little much-divided wayside weeds ; but it spring up erect in tall, thick, luxuriant clumps, growing close together, each stem fringed with a considerable number of moderate-sized, heart-shaped, toothed and pointed leaves. Such leaves have just room enough to expand and to encroaching upon one another's food in mind that leaves grow out of the air, not, as most people fancy, out of the ground), and so without the consequent necessity for dividing up into little separate narrow segments. Acspring up beside the hedgerows in nettles. It is almost exactly imitated

species of like habit ity of external resemblance, under identical circumstances, between organisms wholly unlike in origin and one. Thus, in the dry deserts of India, some of the spurge tribe grow thick and ... ucculent, so as exactly to resemble the genealogically very different cactuses of like dry deserts in America; and a gallinaceous bird, stranded on the shores of the Antarctic Islands, has acquired the long legs of the waders, together with the characteristic colors of the gulls. selection tends always under like circumstances to produce like results.

Then, again, there is the flower of the nettle, which in most plants is so much the most conspicuous part of Yet in this particular plant it is all. so unobtrusive that most people never notice its existence in any way. That is because the nettle is wind-fertilized, and so does not need bright and at- and gets on by their aid; but all have tractive petals. Here are the flower-not the same talents. One survives ing branches, a lot of little forked by dint of its prickles; another by antler like spikes, sticking out at right | dint of its attractive flowers; a third angles from the stem, and half con- by its sweet fruit; a fourth by its cealed by the leaves of the row above hard nut-shell. As regards stings. them. Like many other wind-fertilized flowers, the stamens and pistils are collected on different plants—a is merely one of the ruck. Every plan which absolutely insures crossfertilization, without the aid of the insects. I pick one of the stamenbearing clusters, and can see that it is made up of small separate green blossoms, each with four tiny leaflike petals, and with four stamens doubled up in the centre. I touch the flowers with the tip of my pocket- inquired how much he would ask to knife, and in a second the four stamens jump out elastically as if alive, and dust the white pollen all over my fingers. Why should they act like this? Such tricks are not uncommon in bee-fertilized flowers, because they insure the pollen being shed only when a bee thrusts his head into the blossom; but what use can this device be to the wind-fertilized nettle? I

This peculiar- | during perfectly calm weather it would simply fall upon the ground, without reaching the pistils of neighboring plants at all. But by having pedigree, is a common and natural the stamens thus doubled up, with elastic stalks, it happens that even when ripe they do not open and shed the pollen unless upon the occurrence of some slight concussion. This concussion is given when the stems are waved about by the wind; and then the pollen is shaken out under circumstances which give it the best chance of reaching the pistil.

Finally, there is the question of Whatever the original stock, natural fruit. In the fig and the mulberry the fruit is succulent, and depends for its dispersion upon birds and animals. In the nettle it takes the form of a tiny seed-like flattened nut. Why is this, again? One might as well ask, why are we not all Lord Chancellors or Presidents of the Royal Academy. Each plant and each animal makes the best of such talents as it has got, the nettle is one of the best protected plants; as regards flower and fruit, it plant can only take advantage of any stray chances it happens to possess; and the same advantageous tendencies do not show themselves in all alike. It is said that once a certain American, hearing of the sums which Canova got for his handicraft, took his son to the great man's studio, and make the boy a sculptor. But there is no evidence to show that that aspiring youth ever produced an Aphordite or a Discobolus.

XIII.

LOOSESTRIFE AND PIM-PERNEL.

I HAVE picked this long delicate think the object is somewhat after spray of woodland loosestrife-a pretthis fashion. If the pollen were shed ty, graceful, small creeping flower-

eather it ground, of neighby having up, with hat even and shed courrence This constems are and then ınder cirthe best

estion of mulberry pends for animals. orm of a Why is well ask, ancellors Academy. al makes has got, t all have survives other by ; a third th by its s stings, protected l fruit, it Everv e of any possess; tendenes in all a certain ns which aft, took idio, and d ask to But there iat aspirphordite

PIM-

delicate -a pretflower---

Spinney; where its slender trailing modern reformers, though no doubt stems grow abundantly under the they will be so as soon as the question damp shade of the young alder bushes. is once fairly considered at scientific It does not in the least resemble the headquarters. The loosestrife genus big erect purple loosestrife, that handsome tall water-side plant, whose ing at the top when ripe in five or ten great bunches of brilliant flowers valves; the pimpernel genus was dehang so heavily over the banks of fined, on the contrary, as having a brooks and rivers a little later in the capsule opening in the middle, by a season; for, indeed, the two species line running round it transversely inhave no connection with one another except etymologically, and derive their common name from different sources, the one truly English, the other as a mere herbalist's translation The woodof the Greek *lysimachia*. land loosestrife has small yellow flowers, of a regular and simple sort; and it is by family a primrose, though it hardly looks much like one to a casual ing into two hemispheres at the equaobserver. I have picked it now, however, for comparison with this other allied plant, the common little pimpernel, whose pretty bright red blossoms are familiar friends in every cornfield and waste patch of garden. The two plants are very interesting in their way, as illustrating a curious feature of evolution; and they are interesting, too, as showing the sort of errors into which people were constantly led before the rise of evolutionism by the old artificial way of regarding the relationships between plants and animals.

In all the books about botany, even, I believe, to the present day, you will tind the woodland loosestrife elassed as a species of the genus Lysimachia, while the pimpernel is classed as a species of the genus Anagallis. But in reality, looking at the matter from the new standpoint of descent or actual pedigree, there can be very little doubt that this particular loosestrife by valves; only two or three peculiar is far more closely related to the pimpernel, which is thus placed in a separate genus, than to the other yellow loosestrifes which are included in the lifts off in a single piece. Therefore same genus with it. The reasons that the presumption is that the latter induced the older botanists to make forms are derived from the former, this classification are clear enough, and not vice versa, especially as the and they seemed at the time pe feetly valvalar mode of opening is a com--cogent; nay, they have not yet been mon one among all plants, while the

in the deep thickets of Netherden discarded, I fancy, by any of our was defined as having a capsule openstead of longitudinally. If we consider the capsule as represented by a common terrestrial globe, joined to the stalk at the south pole, then in the loosestrifes this capsule may be figured as dividing into several segments along the meridians from the north pole downwards; while in the pimpernels it may be figured as dividtor. It is just the difference between letting an orange burst open along the natural partitions, or eutting it across the middle at right angles to the partitions. Now, if you look closely at the ripe capsules of the woodland loosestrife, you will see that it splits asunder into separate valves; and, therefore, according to this rule, it is a true lysimachia; while if you look closely at the ripe capsules of the pimpernel, you will see that the top lifts off bodily in a hemisphere or eup, displaying the seeds within as an uncovered sphere; and therefore, on the same principle, it is a true anagallis. So far as this reasoning goes, it is perfectly just and accurate.

> But now, again, if we inquire into the development and history of the two plants, we shall probably come to a very different conclusion. Most of the primose family, to which both genera belong, have capsules opening species, like the common pimpernel, bog pimpernel, and the tiny chaffweed, have capsules opening by a lid which

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But we have something more than such a presumption; we have an actual relic of the earlier habit impressed still upon the very structure of the pimpernel. If you look carefully into its half-ripe capsules (with a small pocket lens, or even without one) you will see five dark brown lines traversing the top of the sphere, from the pole toward the equator, exactly like the meridians on a globe. These are the marks of the valves by which the capsule used once to open. In the yellow loosestrife you will find exactly similar marks; only in that case they are the lines along which the capsule actually splits when ripe; whereas in the pimpernel they only simulate such a purpose beforehand, while the actual mode of opening is by a transverse division. There can be no doubt at all, therefore, that the pimpernel is really directly descended from an ancestor which closely resembled the woodland loosestrife; and that the present peculiarity in its method of opening is quite a modern tions throughout nearly the whole or recently acquired habit. Otherwise, it would not still retain the five valve-marks on the half-ripe capsule the transverse mode of opening its so very distinctly as it still does.

In every other respect except this one point the woodland loosestrife much more closely resembles the pimpernel than it resembles the other members of its own genus. Both are slender trailing plants, with leaves of much the same character; both have small flowers of the same general type, on long thin stalks, which roll back as the capsule ripens; and both have a certain indefinite likeness to one another in the vague points of external appearance, which botanists describe as "habit." It is true, the blossoms of the woodland loosestrife are a pale delicate yellow, while those of the pimpernel are bright orangered; but that is a small matter, mainly dependent upon their insect fertilizers and their different distribution, the possible guides to relationship by one plant loving shady shady copses descent; because, though close likeor moist woods, while the other loves ness in fruits affords a fair presumpopen cornfields and dry barren places. 'tion of close kinship, unlikeness in

transverse mode is extremely unusual. [In general shape, however, and in all important characters, the blossoms are simply identical.

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It is impossible, therefore, to resist the conclusion that the pimpernel is descended, either from the woodland loosestrife itself, or from some common parent form extremely like it. For almost all the distinctive peeuliarities of the pimpernel, except only its trick of opening in the middle, must have been acquired by the parent form before it began to split up into two separate species. The woodland loosestrife, remaining in damp tree-covered spots, has most closely retained the general appearance of the common ancestor, since its flowers are yellow, like those of the other loosestrifes, and its capsule still opens in longitudinal valves. The pimpernel, on the other hand, growing in those bare patches which human tillage renders so common, has become a frequent weed of cultivation over all Europe and half Asia, and has accompanied man in his various migraglobe For some reason or other why, it is hard to say—it has found capsule suits it better than the valvalar, perhaps because this plan saved its seeds in some unknown way from some dangerou animal foe; and so it has universally adopted the new principle in place of the old one. It has also changed the color of its flowers, through the selective action of the fresh insect fauna to which it was exposed under the altered conditions of its life. And, finally, it (or some similar form) has further developed the bog pimpernel and half a dozen other more separate species, as well as the still further differentiated chaffweeds, which depart progressively more and more widely from the common loosestrife pattern.

The fact is, fruits and seeds are naturally in one way the worst of all

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fruits affords no valid presumption divergent form of that particular against it. Two plants may remain | loosestrife which is much more closely alike in their leaves, their stems, their | related to it than to the other membuds, and their flowers, and yet when | bers of the genus Lysimachia. it comes to their fruit, new agencies may be brought to bear upon them which for the first time set up a slight difference between them. This difference may often be very conspicuous, and yet may be of extremely little genealogical importance. Thus the almond and the nectarine are really so much alike in all general points of structure that one may say they are practically the very self-same plant; only in the almond the fruit has a hardish shell, while in the nestarine it has acquired a soft one through the selective action of birds. Similarly, there is a common English potentilla, which exactly resembles a strawberry in everything except the fruit, and that is dry instead of being succulent. Hence we may fairly say that the strawberry is just such a potentilla, whose seed receptacle has become juicy and red, through having been eaten by birds, which aided in dispersing its seeds. made the strawberry into a separate tions, the goldfish; and they have genus because of this conspicuous difference; but in reality the difference is worth very little as an indication of distinctness, for the potentilla train. Some have lost their seales had already acquired every distinctive altogether; some have grown short trait of the strawberry, save only and stumpy, others lean and low; this one noticeable trait of a succu- and some have got their fins lengthlent fruit-stem, long before they ened into a perfect caricature of their diverged from one another; and that natural selves. Carp, in fact, come one peculiarity might be and actually was easily acquired without any change in the general habit of the species.

In all these cases a philosophical biologist can but come to one conclusion. Not only does the strawberry not differ generically from the potentillas, but it is merely a slightly divergent form of this particular tails and stalked eyes, known as telepotentilla, which is much more closely scope fish, that one sometimes sees in related to it than to the other mem- domestic aquariums. In England, it bers of the artificial genus. And so, is true, the carp are comparatively too, not only does the pimpernel not modern denizens; for, in spite of the differ generically from the woodland popular notion that they were largely loosestrife, but it is merely a slightly bred in mediaval monasteries, modera

XIV.

THE CARP POND.

The little stretch of artificial water in Chilcombe Hollow, put there to form an element in the view from the drawing-room windows of the manorhouse, positively teems with great, fat, lazy carp, whose broad dark backs I can just distinguish through the pond when they sail across slowly from one waving bunch of weed to another in their heavy, lumbering, There is a certain overfed way. natural congruity between the carp and the pond-natural, I mean, in the sense that both are highly artificial, just as we might say that a shepherdess in silk skirts with a pastoral crook was perfectly natural in a feterchampetre of the Watteau order. For carp are the most absolutely domesticated The old botanists of all fishes, except their near relaconsequently undergone the usual amount of distortion and degradation which domestication brings in its to us from China, where they have been kept in artificial ponds from time immemorial, after the usual Chinese fashion; and they have been earefully bred and selected for their monstrosities and oddities, which pleased the Celestial taste, exactly as in the case of those marvelous varieties of the golden carp, with expanded

naturalists have decided that they themselves step by step to the most seventeenth century. Yet there is still a certain artificial pond-bred look | rivers into India became the ancestors about them, which makes them har- of the beautiful carp-like fishes of the monize well with these damned-up Ganges and the Indus. Those which sheets of ornamental water. The swift speekled trout suits the stickles and reaches of our own native becks; but the lazy carp suits the slow stagnant pools which are forced upon our spread into the outlying peninsular unwilling scenery by checking the brooks midway on their course through their proper sloping English combes.

Originally, however, the habits and manners of the earp family were very different from those which this particular species has acquired in the sluggish streams, broad lakes, and banked-up ponds of the Chinese low-Dr Günther, our greatest lands. living authority on the study of fishes, has traced the migration and differentiation of the family from its earliest the descendants of these primitive form in its primitive home to its numerous divergent branches over the whole northern hemisphere; and his account is one of the most instructive studies in the geographical distribution of animals that has yet been attempted. At the present day these cyprinoids form one-third of all the fresh-water species of fish known to science. Yet they seem to be a comparatively modern family, not being found in earlier geological deposits than those of the tertiary age. Apparently, the primitive ancestral carp was evolved from some earlier species in the great Himalayan range which divides the temperate and tropical parts of Asia. This was a splendid starting-place for a new family, since linked to the northern continent by the the rivers which take their rise in the Central Asian backbone ridge flow in at Panama which causes so much every direction towards the Arctic, the Pacific, and the Indian Ocean, as well as towards the Aral Sea, which once communicated with the Caspian, and so gave access to the rivers of and ant-eaters; so that into South Russia. accordingly set out on their travels yet had time to penetrate. Of course towards the plains on everyside; and they are equally absent from the as they went they accommodated islands of the Pacific, cut off as those

were first introduced here early in the varying tropical or sub-Arctic conditions. Those which descended the slowly made their way into China gave birth to the domestic carp, the goldfish, and many other species. And those which still more slowly tract of Europe differentiated themselves into our familiar barbels, gudgeons, tench, chubs, dace, roach, and minnows.

> From Europe the carp kind made their way into the New World. As early as the pre-glacial epoch, fossil forms show us that the cyprinoids had already migrated into America, no doubt across the fresh waters in the belt of land which once lay upon the high submarine bank between Scotland, Iceland, and Greenland; and immigrants now form the suckers, white mullets, shiners, whitefish, and red-fins of the Canadian lakes and Thus the cyprinoids have rivers. spread over the whole of the old Continent and of North America. But the sea forms the great barrier in the way of migration for fresh-water creatures; so that they have not yet been able to get beyond the limits of this northern land-service, long united in a single continent by the elevation of the Icelandic bank. Australia, we know, has never been joined to Asia or the rest of the world since the cretaceous period at least, and therefore there are no cyprinoids in Australia. South America has only recently been elevation of the narrow mountain belt trouble to M. de Lesseps, and it still preserves for the most part its own very antiquated and isolated fauna of llamas, alpacas, armadillos, sloths, The primitive cyprinoids America, too, the cyprinoids have not

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As fossil ls had a, no in the on the Scot-; and mitive ickers, h, and s and s have d Con-But in the -water not yet mits of united evation lia ,we to Asia the creerefore istralia. tly been ht by the tain belt b much d it still its own auna of sloths, o South have not f course rom the

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rest of the world by a broad and apparently fit them for a marshy or practically impassable stretch of deep sea. If one might hazard a guess as to the future, apart from the interference of man, it is most likely that the abundantly in the tertiary fresh-water carps will first pass down the Isthmus of Panama into the rivers of the Andes, and thence, as the mountain species gradually accustom themselves to lowland tropical conditions, into the Amazon valley; that their invasion of Australia must be deferred till some slow secular elevation has done away with Torres Straits and the Java Sca; and that in all human probability they will never naturally get over the obstacles which seem to shut them out forever from the archipelagos of the Pacific.

In their origin the cyprinoids were thus Alpine fishes of the torrents, not lazy lurkers on the muddy bottoms of inland ponds. It is only the accident of their long residence among the great alluvial levels of the Chinese basins which has given our own domesticated carp their distinctive speeific features. Most of the cyprinoids are still lovers of running water, and many species still haunt the upland torrents of their native Central Asian home. Another family, the siluroids, is by descent the really typical group of muddy water fishes. In England, we have no siluroids—our streams are too pure and clear and rapid for thembut in Germany the slow rivers of the eastern plains support the big wels, and in America the cat-fishes are found abundantly in all swamps and shallow waters of the great central level. Dr. Günther has traced the migrations of this important group, as well as those of the carps-they form now about one-fourth of all known fresh-water species—and has are no lovers of cold water. Only shown pretty certainly whence they came and how far they have gone. rope, and but few into temperate The siluroids are essentially fishes of the sluggish waters in the plains, and though more numerous, belong all to they seem to have had their origin in a single group. Towards the south tropical countries, where they still temperate regions, where the land flourish best. They have no scales, tapers slowly southward, they spread but are clad in a slippery skin; and slowest of all; so that the family is

oceanic archipelagos are from all the, they have always long barbels, which muddy life. Probably they were developed at a later date than the carps; for, while we find fossil cyprinoids limestones of Oeningen and Stein. heim, in the lignites of Bonn and Bilin, in the slates and shales of Sicily and Sumatra, and even in the Idaho deposits of North America, we find no fossil siluroids in the European tertiaries at all, nor anywhere nearer than the fresh-water strata of the Malay Archipelago. Hence we may fairly conclude that at a period when the carps were already widely spread over the whole northern hemisphere, the cat-fish were still mainly confined to the neighborhood of their original tropical home.

Nevertheless, the primitive siluroid had some striking advantages on his side, which have enabled his descendants to outstrip the carp, considering their juniority in time, in the race for the occupation of the fresh waters of the world. Not only does their skeleton show certain very special modifications adapted to their peculiar mode of life, but they are also comparatively cosmopolitan in their tastes, being able to enter the sea, to which some species have taken permanently, though still keeping for the most part to shallow muddy bottoms. As they are thus but little deterred by intervening oceans, they were enabled to spread rapidly over the whole of the tropics, reaching Northern Australia from India, and even crossing from South America to the Sandwich Islands. As yet, however, they have not made their way into the coral islands of the Pacific. Northward they spread far more slowly, as they one species has penetrated into Eu-Asia. The North American kinds,

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entirely wanting in Tasmania, New on purpose to display to him the Zealand, and Patagonia. Facts of nature and succession of the strata. meaningless before we obtained the walled-in Welsh lane is fraught with key of evolutionism; but with that much interest of its own for those key to open their meaning they be- who choose to look at it aright. For come at once speaking evidence as to the boundary walls are built not of the former migration and relative square-quarried stone, but of round descent of the whole group of crea-land shapeless boulders, often thickly tures to which they refer.

VIGNETTES FROM NATURE.

XV.

A WELSH ROADSIDE.

Buyovo Pensarn the walk begins to snow tame and somewhat tedious. half-way to Dyffryn, it is true, the long, low range of the Llawllech hills is eleft by the little torrent valley of the Artro; and just there the view opens up behind into the beautiful glen of Cwm Bychan, backed by the grand, bald summits of the two Rhinogs and their sister hills; but beyond this one glimpse of the wild mountain country in the rear, the consists for the most part of one huge highway becomes decidedly dull and monotonous. On one side stretches the lowland, protected from the sea by a succession of blown sand dunes, which almost hide the horizon with like raisins and currants in a school their line of stunted mounds; on the plum-pudding. That is what makes other side rises the dreary, unbroken this low range so monotonous and range of Llawllech, a mere treeless uniform in surface; it displays no slope of scanty barley and stony pas-|jagged and weathered eraggy rocks, ture land. To right and left, the lane no deep glens cut by ice or rivers, itself-for it hardly deserves to be but it still shows for the most part ealled a road—is bounded by stone only the long, rounded, sleping conwalls, which often shut out what little tour of the original moraine, slightly view might otherwise be obtained cut through in places by uninteresting over flat shore, distant sea, or barren streams. In the railway enttings behillside; so that altogether, for the low one can admirably see the commere lover of the picturesque, the six position of the moraine, with its miles' walk hence to Barmouth forms ground-tone of mud and its intera very uninteresting termination to a spersed boulders; while here by the

even the dullest scenery often presents the sake of a clearance, and piled up objects of special interest which would loosely to make a rude stone wall. never strike the casual unscientific In the Snowdon district, especially observer. Railway cuttings, which along the pretty drive through Nant appear to most people mere blank in- Gwynant from Beddgelert to Capel terruptions of the general prospect, Curig, numbers of sections have been assume for the enthusiastic geologist made in the moraines for road metal.

distribution like these were utterly Just so this somewhat weary bit of dappled with patches of grey or orange lichen, and loosely piled together, in rough primitive fashion, without cement or mortar. If one examines them closely they prove also to be scratched and grooved with parallel lines; and these lines the geologist at once recognizes as due to the grinding action of the glaciers. The boulders, in fact, were transported hither by the great ice-sheet which once covered the whole country side hereabouts, and which ran out far into the bed of what is now the Irish Sea

Indeed, the entire side of Llawllech moraine, a mere mass of glacial débris, mainly made up of fine mud, with ice-worn boulders and pebbles disposed loosely through its midst, pleasant and diversified day's tramp. roadside one finds just the self-same To the geological eye, however, boulders, picked off the ground for the guise of delightful sections made the hard boulders being dug out and

VIGNETTES FROM NATURE.

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fuse-piles - roches moutonnees, as they call them in Switzerland-perfect domes of bare stone, even now sharply grooved and marked with the strike scratched upon them by the superincumbent ice stream.

that the walls are very much thicker big moraine. Some of the smaller than they need be for practical purpose; indeed, in some places they shapely stone hatchets of paleolithic are as much as four or five feet broad. The truth is, such walls are rather a indistinguishable roundness by the simple way of getting rid of the enormous friction of the moving boulders than a protective margin to the fields. these glacial slopes, the first thing to boulders come from by the nature of do is to weed out the surface boulders; and the easiest plan of doing so is to this bit must have been broken off pile them up all around the stubbed the side of Aran, that bit must have portion of the field. The thickness been detached from the summit of of the wall depends upon the number | Rhinog, and this other again must of the boulders. many the field is small and the wall slopes of the Berwyns. But, if any big; where they are few the field is larger and the wall not quite so clumsy-looking. In some places, however, even the wall does not suffice to use up all the loose fragments; and then they are often packed in the corners so as to cant the angles with a small flat-topped triangular platform. Of course the very stoniest bits are wholly uninclosed, or given over to mountain sheep, who find a scanty pasture in the chinks between the boulders; and the valleys of the little rivulets are almost always mere gorges of naked round stones, because here the water has washed flora of England, that this total away all the soft earth between them. Such denudation is always going on more slowly, even in the other parts; and the plain or marshland which lies between the foot of the hills and the sea has been built up by the detritus before the last great ice-age was thus carried down from the moraines, and protected from incursion by the hillocks of blown sand.

broken up for this utilitarian purpose; that every one of these big round and on the slopes above, near the stones has been once like ourselves a mountain tarn of Llyn Llydaw, one tourist, and has traveled on the side may still observe the huge bossed our- or bottom of a glacier to its present faces of the native rock worn by he place, and that, too, at a date long glaciers which heaped up these re- subsequent to the undoabted arrival of man upon the earth. It was many ages after the low-browed black fellows hunted the rhinoceros and the mammoth in the swamps of Gray's Inn and the jungles of Fleet street, that the ice-sheet bore these boulders It is impossible to avoid noticing down the sides of Llawllech to this pebbles may even once have been man, long since ground down into glacier. In most cases, one can go In trying to cultivate so far as to decide actually where the the rock from which they are derived ; Where they are have traveled all the way from the of them ever bore any trace of human workmanship, all semblance of manufactured articles has long been worn away from their surface by the grinding ice-mill. It is only in the protected floors of flooded caves or among the subsisting drift of glacial and interglacial rivers that we can now find any traces of man's early handicraft. Everywhere else the ice-sheet has planed everything bodily off the face of the land: that is why we find few or no paleolithic skeletons. And we must never forget, in estimating the past history or present fauna and blank in our geological and archæological annals cuts in like a complete interruption between the two known ages of human life in this island. Everything that existed in Britain cleaned utterly off the face of the country by the vast system of glaciers which then grew up; everything that It is interesting, however, to think now exists in it has come into the

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land since the date of that gradual | sap slowly circulating, even in the but all-embracing cataclysm. men, the animals, the plants which lived here before the ice covered the country belonged to extinct types, or to species now confined to southern climates; when the ice cleared away it had swept off almost every relic of their existence, and a new race, a new fauna, and a new flora came to occupy the virgin soil.

XVI.

SEASIDE WEEDS.

BEHIND the bar which closes the wide throat of the estuary here at Stourmouth a long expanse of sand stretches away inland almost as far in their broad leaves or thick stems as the weirhead that marks the high-till they require it for use. Just as est point of tidal action in the little the camel takes one long drink before river. Some of this sand lies below starting, which supplies his wants for the level of high water, and is there- some days in the desert, so the saltfore very soft and smooth and muddy; wort takes one long drink at each but a large portion of it stands al-shower and subsists upon that till the ways high and dry, blown about into next rainfall. uneven ridges and hollows by the strong winds that rush down the can be easily traced by means of its opening between the two parallel own existing structure. By origin it ranges of neighboring hills. As I is one of the goosefoots, a family of sit upon one of these ridges watching small, weedy-looking plants, which the slow clouds drifting landward be grow abundantly in all wasts places fore the westerly breeze, I have and over heaps of rubbish near cultipicked from between the sand a little vated ground. creeping weed, root and all, with thick, fleshy, cylindrical leaves, and still essentially a goosefoot flower—a a stout thorn at the end of each. It mere inconspicuous little green blosis a common seaside plant-saltwort som, hidden in the angle between the or kali; and, like sand-loving plants stem and the leaves, after the fashion generally, it has very succulent and of many plants which have not learnt juicy foliage. The reason for this how to develop bright petals for the neshy habit under such ci. umstances attraction of insects. But the gooseseems clear enough. Marshy plants, foots, in the course of their spread or plants which live in ordinary over the earth, would often shed their moist soils, can get plenty of water seeds upon sandy places; and being whenever they want it, and so they as a rule originally rather disposed to need not store away any against fleshiness, especially in the stems, emergencies in case of droughts. they must often have managed to Even dry hillside shrubs, like the live on even in these unfavorable rosemaries and heaths, can thrust situations where most other plants their roots deep into the earth, and so would starve or wither outright. Of

The driest Summer weather; but weeds which live on sand must economize water whenever they can get it. The rain that falls upon the spots where they grow sinks rapidly through the surface, and in a few hours the whole place is just as dry as it was before the shower. Accordingly those plants which have accommodated themselves to such situations have necessarily acquired very thick and fleshy leaves; and this acquisition was the easier to make, because proximity to the sea produces in all plants a slight succulent tendency. As soon as rain falls they drink up all the water that comes in the way of their spreading rootlets, and then they store it away

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The history of this seaside weed

The flower of the kali, indeed, is manage always to get a little supply of moisture, surfacent to keep their hard, crisp foliage alive, and their set their seed; and these seeds, again,

VIGNETTES FROM NATURE.

would produce young plants, most of spine, which of course runs into the which would be just as succulent as their parents, while a few would donkey. In many cactuses, again, doubtless surpass them in this respect. As such natural weeding out of the thorns, which cover the surface of the least adapted forms would occur with cylindrical stem, and form the most every drought, and as the best adapted which lived through the droughts by virtue of their superior fleshiness Indies, cactus hedges line all the roads would occasionally cross with one in the plains, and rise in a solid wall another, either by wind-fertilization or by stray visits of pollen-hunting midges, it is clear that in the course of time a new succulent species would be slowly evolved. \cdot As a matter of fact, the goosefoots have really given origin to several such sand-loving weeds, each of the principal groups having probably a separate origin from some particular kind of strictly terrestrial goosefoot.

After the saltwort had grown succulent it began also to grow prickly. For sand-loving plants are naturally exposed to very great danger from herbivorous animals, against which they are accordingly compelled to protect themselves by some hostile device. In the first place, there is comparatively little vegetation on sandy spots, so that each plant runs an exceptional chance of being eaten. Then, again, the succulence and juicyness of sand-haunting weeds make them particularly tempting to thirsty animals, which are sure to eat all un-Hence, as a protected specimens. rule, only those survive which happen to have developed some unpleasant personal peculiarity. Many sandhaunting or desert plants are more or less pungent or have disagreeable alkaline essences stored up in their leaves, and these alkaline constituents, which they easily obtain from the soil, formerly caused many of them in general external appearance. By (saltwort and glasswort among the pedigree the two families are wholly number) to be burnt for carilla. In unconnected; but in America certain avoiding the Scylla of animal tastes such plants fell into the Charybdis of human industrial usages. But most having got loose on the sand-wastes sand-loving weeds have solved the of the tropical belt, adapted themdifficulty in another way by simply selves by thei. succulence and their

nose of any too inquiring cow or the leaves have been reduced to sharp effectual possible protection against the attacks of animals. In the West to a height of fifteen or twenty feet. No animal on earth dare attempt to pass through such a hedge; and the task of cutting one down, when necessary, is extremely difficult. On bare dry expanses, like the Mexican plain, eactuses and agaves run wild in every direction, collecting what little moisture they can in their thick stems or big succulent leaves, and defending it against herbivorous enemies by their formidable spines. To prevent evaporation, they are covered by a thick and very firm epidermis, so that they lose very little of their moisture even during months of drought.

What these great desert plants do on a large scale, our little English saltwort does on a much smaller scale. It has the same strong prickles, the same thick, juicy leaves, the same protective epidermis, and the same general aspect or habit of growth as the cactuses themselves. If one were to enlarge it twentyfold, every casual observer would set it down as a desert species at once. Indeed, so naturally do all these peculiarities result from the mode of life affected by sand-haunting plants, that in India, where there are no true cactuses, certain native spurges are universally known by that name, because they so exactly resemble them weeds of a kind something like our own stone-crops and house-lecks, acquiring thorns or prickles. In the defensive prickles to the necessities of saltwort, each leaf ends in a stout their new situation, while in Asia-

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kind closely resembling our spurges and mercuries happened to establish themselves on the similar sand-wastes of sub-tropical India, and necessarily adapted themselves in just the same manner to just the same sort of situations.

In fact, we now know that these adaptive and functional resemblances are the worst possible guide to relationship by descent. Almost all plants which grow under water have very finely divided leaves; but they are all aberrent members of the most diverse and widely separated families. They have been compelled to acquire long, thin, waving leaflets because there was so little carbonic acid in the water where they lived that they could not extract carbon enough from it to build up a full, large, round type of leaf; exactly as all aquatic animals have much-branched gills to eatch the stray floating particles of free oxygen dissolved in the water, while all land animals have big internal lungs, into which the abundant free oxygen of the atmosphere pours copiously at every inhalation. Put any two distinct groups of plants or chester, who is making such a pretty animals into exactly similar circumstances, and the chances are that they will adapt themselves to those circumstances in exactly similar ways, thus masking their original unlikeness. But if you examine their minute internal structure, you will probably still find many small points of deepseated difference, underlying their was unpropitious for sketching in the external adaptive similarity; and these points are the important clues which aid us in discovering their real | a few hours for fishing; so here we are relationship to unlike groups elsewhere. America and the sun-birds of India are extremely similar in outer appearance, because they are both highly gasps, while I am calmly prepared to adapted to a flower feeding existence; watch and report upon its specific pebut their minute anatomy shows that cultarities. I have certain compuncthe one family are modified swifts or tions of my own about the morality swallows, while the other family are of catching a live trout for such a modified tropical fruit-eaters. Hence purpose; but as my artist friend still we are landed at last in the apparent continues angling for more, which, paradox so ingeniously pointed out when caught, I shall doubtless eat for

certain totally distinct weeds of a by Mr. A. R. Wallace, that the less functionally vscful any structure may be, the greater becomes its value as a test of relationship by descent.

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XVII.

A MOUNTAIN TARN.

One could not find many pleasanter seats in England, or Wales either, than this big dry boulder, with a niche that seems intentionally designed to accommodate the contour of the backbone, overlooking the calm surface and bare craggy sides of a little mountain tarn. I have come up here this morning on sport intent, to find a specimen of a peculiar species of trout, which haunts this one tiny sheet of water, and occurs nowhere else in the whole universe. Not that I am an active sportsman myself; my portion of the service is always confined to the attitude of those who stand and wait; and I don't even stand to-day, having found so comfortable a seat in the water-worn hollows of a granite boulder. But the young landscape painter from Manpicture of the glen from his tent close by, can throw a fly as well as any man in Lancashire; and when I mentioned to him some time since my wish to get one of these local trout as a specimen for examination, he promised to entice one up for me on the very first morning when the light glen. To day he dropped in after breakfast to tell me he could spare me beside the tarn, and here is the Llyn Thus the humming-birds of Gwernant trout in person, flapping and floundering on the bare rock at my side—poor creature !—in its last

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asanter either. a niche ned to backurface little p here to find ies of tiny where ot that f; my s conwho even comn holit the Manretty close any mene my out as romn the light u the after e me e are Llyn ping k at last d to peunelity h a still ich, for

as well stifle my scruples now, and a narrow compass, and thus squeezed take notes of my trout while the is hard against the sides and bottom of still fresh and lifelike. After all, it is the gorge by the pressure of the great just as legitimate, I suppose, to catch | ice-sheet in the rear. If you look at a fish in the interests of science as to the rock anywhere around the lake catch it for the sake of dishing it up you will see that it is worn quite at supper in a tempting brown case smooth and deeply scratched with of egg and bread-crumbs.

tion about the right of the Llyn in Switzerland at the present day. Gwernant trout to rank as a separate |So the rock-basin in which the tarn species. The marks which distin-lies must itself be a product of the guish it from the common speckled scooping action of the glacier. When trout of English brooks and rivers the ice melted away under the genial are many and undeniable. But the elimate of the post-glacial period, a question how it came here is a very little stream took the place of the vast eurious and interesting one. We have frozen mass, and this stream expanded in Britain all together some twelve in the hollow till it filled the small kinds of trout, peculiar to our own lake and then ran out at the lower islands; and most of them are limit-end. Hence the arrival of the trout ed, as in this case, to a single station, usually a mountain pool with only one precipitous outlet. On the old than the end of the last ice age. theory, which represented every spe- Whatever peculiarities they may discies of plant or animal as the direct play when compared with the parent result of a special creation, we could type must have been developed since have had no alternative but to sup- that time. Indeed, even if the lake pose that each of these kinds of had been here before the glacial mountain trout was specially created epoch, the ancestors of these trout in and for the particular little pool where we now find it. But the new theory of evolution simply teaches us that each trout has been evolved under have entered the island since the icepeculiar circumstances to suit the sheet cleared away. special conditions of these isolated sheets of water in which they live Let us look a little closely at the position of Llyn Gwernant, and eonsider why a unique kind of trout should have been evolved just there rather than elsewhere.

The tarn itself, one can see at a glance, must be a glacial hollow. It was scooped out by the grinding action of ice in the last glacial epoch. Look up the glen, and then down, have speculated not a little on the and you will see that in either direetion the valley widens out from the gesting that they were carried hither lake as a centre; but just about the by a waterspout, another that the neighborhood of the lake itself the eggs were bron, ... t into the pool clingsides trend inwards, so as to inclose ing to the feet of a water-fowl, a a small pass or gorge; and when the third that the ancestral fish were whole combe formed the bed of an placed in situ by the finger of the ancient glacier, the ico in this part Aimighty-which latter metaphor he

supper with a clear conscience, I may | must have been crowded together into ice-marks like those which occur just There can be no doubt or hesita- below the Summer level of a glacier could not have dwelt in it; for we know that every species of animal now living in Britain must necessarily

> How did the tront first get into the tarn? That seems at first sight a difficult question, for the only stream that communicates with it is the little torrent, broken by a hundred small cascades, which drains its waters into the river below. No fish could now possibly leap up these continuous waterfalls from ledge to ledge, some of them as much as twenty or thirty feet high. Hence local naturalists origin of the trout, one theorist sug-

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does not deign to explain for us in peculiar way. In the rivers of the full. For my own part, I do not incline thus clumsily to solve the prob- attacks of pike and other savage and lem with a deus ex machina; one cannot fairly consider it a dignus vindice nodus. It seems to me more the lowlands, they hide among weed likely that when the fish first came here the little stream still flowed in a moderately continuous basin, worn for it by the glacier, down to the level of the river, which then ran in a far higher channel than at present. Up this gentle incline the trout which were slowly spreading through the unoccupied fresh waters of Britain,

after the thawing of the great ice-

sheet, must have made their way into

Llyn Gwernant. But when they had once got there, the brook and the river went on carving their basins through the rock and the glacial soil, till at last they reached their present levels, the three highest falls on the brook being just those where it meets the newer valley of the main stream by Dolserau Mill. So after a while no more trout could in mind that, while the isolated colreinforce the small colony in the tarn, which would thus have room to develop in their own way to suit their own peculiar circumstances, without any cross of fresh blood from the old stock to keep them true to the general type of the race in the lowland rivers. For, as Mr. A. R. Wallace has ingeniously pointed out, such isolated divergence has been double-sided. mountain pools are really the aquatic equivalents or analogues of oceanic islands. In all such limited and hermetically closed habitats every stray use the deviations of this Llyn denizen is liable very rapidly to undergo considerable changes. The nature standard. of the food stuffs is new, and their Gwernant troutlet, in his d sire to variety but scanty; the enemies, if see the world, leaps the caseades and any, are fewer in number and differ- ventures down into the river, we may ent in kind; the conditions are in be sure he is snapped up bodily by every way more restricted and more the first pike that meets him; and absolute than elsewhere. have here in an intense degree all the spread else where. It is only suited known factors of species making. On to its ow: habitat; while the comthe one hand, spontaneous variations mon speckled trout of our rivers are are more likely to occur through adapted to avoid the various greater change of food and circumstances; dangers of their wider world. If we on the other hand, selective action were to compare together all the must be exerted in a very special and special mountain trout of the various

lowlands, trout are exposed to the predaceous fish; here, they need only fear the herons and the angler. In or under banks; here, they are exposed in full sunshine against a light weedless, gravelly bottom. In the lowlands, they feed largely upon land worms and other straggling prey; here, they subsist almost entirely upon flies and other winged insects. Accordingly, the qualities which insure success in the one habitat are quite different from those which insure success in the other; and as the successful alone survive and propagate their like, it is not surprising that ever since the end of the last ice age -probably no more than some 70,000 years since—as many as eight or ten separate species of mountain-tarn trout should have been evolved in the British Isles alone.

At the same time, it must be borne onies in these little pools have been slowly altering in one direction under the influence of changed condition and of a more specialized natural selection. the trout of the lowland rivers have also doubtless been altering in another direction, under the influence of stronger and fiercer competition. The We must not take the existing lowland trout for a true representative of the common ancestor, and then meas-Gwernant species by that fallacious If ever a young Llyn Hence we that is why this rare species has never pro cer res mo rec act by Ste an

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Welsh and Scotch pools, we should the flowers which they most frequent. probably find that they all agreed in Indeed, we know geologically of no certain broad characteristics which labiates before the late tertiary period, really recalled the original ancestor more fully than the lowland species Only these broad charrecalls him. acteristics would be largely masked by the special adaptation of the Loch evolved side by side for one another's Stennis trout to the pools of Orkney, and of the Llyn Gwernant species to this particular petty Welsh tarn.

XVIII.

WILD THYME.

EXCEPT only Scotch heather—that artistic saving grace in our cold grey Northern hills-I know no English plant which produces such brilliant masses of warm color on a large scale as the little creeping blossoms of the wild thyme. Here on the hillside, between the jagged and jutting edges of rock, the rich black peaty soil is thickly overgrown with tangled patches of its purple flowers; and the sweet scent and the hum of bees mingle in one's mind with that in-the cup in the hemp-nettle is filled by definite literary charm derived from four little flattened nuts or seeds, faint suggestions of Puck and Oberon to make this mellow autumn afternoon seem for a moment like a little bit of Shakespeare's dreamland. For wild thyme is essentially a bee-flower, and wherever it grows you may see the big burly humble-bees and the of its function in life. But if you slender little hive workers, with their cut open the calyx of the overblown honey-bags well distended and their thyme blossoms with a sharp penknife legs clogged by pollen, bustling about you will find that the barrenness is eagerly from head to head of the only pretended, not real. tempting blossoms. The whole labiate seems to be the bottom of the calyx kind, to which wild thyme belongs, is really a thick wall of interlacing has been developed in strict correla- hairs; and beneath this wall lie four tion with the shape and habits of bees. little nuts, just like those of the hemp-No other family of plants (except the nettle, only on a smaller scale. orchids) has flowers more curiously again, you cut open one of the fullshaped than those of the salvias and blown blossoms, you will find that these horehounds; certainly no other family hairs may be seen inside the calyx is so noticeable for sweet or aromatic even while the corolla tube is entire, scents as this, which includes the sage, but they are then pressed back against mint, thyme, basil, rosemary, balm, the throat by the tube itself. As hyssop, patchouli, marjoram, lavender, soon, however, as the tube and the and catmint. Such scents are always corolla wither and fall out-which

which is just the time when highlydeveloped bees began to present themselves. The honey-seekers and the honey-producers seem to have mutual benefit.

There is another noteworthy point, however, about the wild thyme which marks it off from the rest of the labiates in one respect as a very special and peculiar form. If you pick a little spray from the clump that covers this hollow in the rock basin you will see that it has some small unopened buds at the top end of the spike, some full-blown blossoms halfway down, and some overblown flower cups on the stalk below. Now, if you look into these overblown cups you will see that they are apparently very shallow—much more shallow than in this bit of hemp-nettle-another common labiate-which I have picked for comparison with them. Moreover, while that of the thyme seems to be empty. Of course the object of all flowering is the production of seeds; and one might at first sight be tempted to suppose that the thyme was quite barren, and so failed entirely What If, due to the selective action of the they do at once when they have higher insects, and are found only in played their part in the economy of

of the to the ge and ed only ler. In g weed are exa light In the on land prey; ly upon 8. Acinsure e quite insure le sucpagate g that ce age 70,000 or ten n-tarn in the

borne ed cole been under on and ection, s have lother e of . The sided. lowive of meas-Llyn icious Llyn re to s and may ly by and never uited com. 's are eater f we the rious

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the plant by inducing a bee to visit | resting; but when the invasion is only and fertilize it—the little hairs, re- directed against a common weed none lieved of this pressure, jump out by but naturalists observe its course, and their own elasticity, and completely even they can hardly obtain the obstruct the entrance to the calyx, proper data for estimating its adthus forming, as it were, a false bot- vance, since nobody keeps a record of tom. Unless you were in the secret the acreage under knotweed, or the you would take it for granted that the calyx was empty, and had either shed its nutlets or else never contained any at all.

which the plant wishes to produce; truder by some small peculiarity of or, to put it more correctly, it is be-|structure, they will survive when their cause the plant has thus succeeded in fellows perish, and a new species will producing a wrong impression on the tend to be set up, possessing the peminds of birds and insects that it has cultarity which saved the lives of its acquired this false bottom of interlacing hairs, and has so survived in the struggle for existence Why the the wild thyme and its close relative wild thyme finds such deception pay the marjoram. is simple enough to understand. Here selves exposed to some special danger close at hand is a bit of mouse-ear which did not threaten the other and chickweed, well in fruit. The plant larger labiates; and those alone suris covered by numbers of little capsules, each containing a dozen seeds form this fringe of hairs oncealing or more; but if you cut them open the nuts within. Perhaps the selectyou will find almost every capsule, in |ive agency at work was some small this district at least, has been invaded bird or insect which could not tackle by a perfect plague of little red or orange worms, which devour most of dead-nettle and the stachys: perhaps the seeds before they arrive at ma-it was some creeping worm against Hence the chickweed, being turity. unprotected against their depredations, is obliged to produce an enormous quantity of seeds, at a ruinous cost to its constitution, most of which get eaten up without doing any good its seeds against some danger to at all to the species. For aught we know to the contrary, these red worms may be now in course of exterminating viduals which possessed it finally the chickweed, much as the Colorado survived in the struggle for life. beetle would exterminate the potato, or as the phylloxera would extermil for ripening fruits or seeds are comnate the vine, if we did not invent all mon enough in nature; but it is kinds of Paris greens and institute all sorts of national quarantines to form or device which they assume. check their triumphal progress. Every Here, for instance, in the bit of boggy now and then some new insect pest in | land formed by the little rill on its this way sweeps across a continent, way through the rock basin, another killing or threatening to kill sine small labiate grows in profusion, the particular species; and when the lesser skullcap. Now skullcap takes plant which it attacks is one useful to its name from a peculiarity of its own, man we note and chronicle its advance, which answers in a different way just which we are often successful in ar- the same purpose as the interlacing

average yearly yield of the goosefoot crop.

Now if, in such a case, any particular plants of the infested species Now this is exactly the impression happen to be protected against the inancestors. This, or something like this, is what must have happened to They found themvived which possessed in a nascient the larger and harder nutlets of the which the stiff and prickly stem hairs of the bigger species formed an efficient chevaux de frise. At any rate, the hairy fringe in the throat of the calyx of the wild thyme protected which they would otherwise have been exposed; and only those indi-

Such special means of protection curious how vast is the variety of pe

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raised spur, which looks something like the shade of an old-fashioned cap while the flower is in full bloom; but as soon as the corolla has withered the upper lip of the calyx closes over the four nutlets, while this scale assumes its place and so produces the effect of an empty seed-vessel. Any prying bird or insect which looked into such a calyx on its foraging expeditions would be sure to conclude that it had already shed its seeds, and so go off to another plant. Thus in two closely related species we see two totally different plans for securing the self-same end. In one group, the originally accidental presence of a few hairs in the throat gave rise to a new departure in one direction; in another group, the habit of closing over the nuts, with perhaps the rudiment of a scale on the back, gave rise to a different departure in another direction.

The hop supplies us with a very similar case in a widely unlike family of plants. Hops, as Kentish farmers know only too well, are liable to attack from "the fly" and many other To protect their seeds, the enemies. hope of future generations, from these marauders, the vines have hit out the plan of producing hops, that is to say, little leafy imbricated cones which covers the blossoms. After flowering, the scales of the cone become much enlarged, and quite conceal the small seed-like fruits; and it is these protective organs which we Northern nations apply to our own uses, corrupting corn with them, as Tacitus naïvely remarks, in quandam vini similitudinem. Indeed, it may be said roughly that human beings invariably defeat the original intention of plants, by cultivating and day's work to a dinner of herbs of the selecting them in order to eat up those toughest, and he forgets the pessimvery seeds, fruits, roots, and tubers istic problem forthwith in the delights which the plants themselves had of freedom and the exquisite pungency richly stored with starches, albumens, of his tuft of thistle head. Shall we and other food-stuffs for the use of not strive to make life a little easier themselves or their descendants. We in the future for such a patient, hardplunder the storehouses which the working, brave-hearted, indomitable species designed for its own benefit : little philosopher as this?

hairs of the wild thyme. On the |yet by saving some for seed and sowback of the calyx is a large scale or ing it in fitly prepared places we keep up the life of the species far more effectually than it could ever have been kept up had the plant been left entirely to its own devices.

XIX.

ANCESTORS. THE DONKEY'S

HE is a dear shaggy old donkey, with the true pathetic donkey eyes, and that wonderful donkey power of making himself perfectly happy on a bare rocky hillside, upon four sprouting thistles, a bit of prickly carline, and three square yards of wet turf at the outerop of the little spring, overgrown with rank bog-asphodel and stringy goose-grass. Given this delicious pabulum, with five minutes' total freedom from beating or bullying, and your shaggy donkey is in his seventh heaven. That is what constitutes the true poetry and pathos of his life. I am not ashamed to side with Coleridge on that question, in spite of the sneers in "English Bards," or in "Rejected Addresses." Α donkey is a really pathetic and sympathy-rousing figure in nature, because, with all his hard blows and buffeting, he retains to the last a brave cheery philosophy which teaches him to take an optimistic view of things whenever it is possible—a sort of monochronic hedonism under diffieulties—that contrasts favorably with the despondent Hartmannic theories of the universe so much in favor with well-fed and bushy-bearded German professors. Schopenhauer's demonstrations trouble him not : Mr. Mallock's doubts as to the abstract desirability of existence enter not into his thoughtful pate: let him but loose from his hard 46 [497]

How, indeed, could the common and universal notions about the stupidity of donkeys ever have originated. A sheep, if you will, is stupid, and so is a rabbit; but I doubt formations of America by Professor whether there is really in all nature a more careful, sensible, intelligent, and wide-minded brute than the common donkey. I have always admired the genuine penetration of those South American mountaineers who told Mr. Darwin that they would give him the "most rational" mule on which to cross a dangerous pass of the Andes. They knew the capacities of the mule; and I have no doubt they knew those of the donkey too. The fact is, every one who has watched donkeys closely must have noticed innumerable proofs of their unusual mental gifts. They stand, with the horse, the elephant, the hind foot, and probably to each fore camel, and the monkeys, at the head foot as well. Already, however, this of the animal world, intellectually considered. (Dogs, of course, I put out) of consideration, as products of direct human teaching). But donkeys are the final flower of long ages of native evolution, the natural head and crown for one of his five toes is, even at this of one great line of mammalian de-To doubt their intellivelopment. gence is to impugn the whole conduct of nature, to upset the entire system of evolutionary psychology off-hand. Donkeys cannot help being clever, because they are the final survivors in the struggle for existence in one of the most specialized, most highly Nebraska, we find two more specialdeveloped, and most dominant mammalian stocks. They do not represent mesohippus, as big as a sheep, with mere stranded and struggling relics three hoofed toes on the front feet, of of older types, like the very silly kangaroos, and ant-eaters, and hedge- largest, being, in fact, the forerunner hogs, which drag on a miserable of the one final hoof in our own horses. existence behind the times in out-of- In the pliocene, again, we come upon the-way holes and corners of the the bones of hipparion and protoearth; they are one of the finest developments of one of the most successful branches of the great progressive ungulate tribe. I feel a genuine respect for every donkey I meet when I remember that it was the mere accidental possession of an opposable another even more specialized type, thumb that gave my ancestors a start pliohippus, in which the lateral toes over his in the race for the inheritance have become reduced to mere splintof the earth towards the very close bones, as in our existing species. of the tertiary period.

Of course everybody knows the wonderful pedigree of the horse and donkey family, which has been discovered imprinted upon the later Marsh, and reconstructed for us in full by Professor Huxley. The horses are an extremely aberrant form of the ungulate tribe, and their very earliest recognizable ancestor must have had some points of resemblance with the tapirs, some with the pigs. some with the deer-nay, some even with the prototype of the lemurs and of man himself. In the lowest eocene beds of New Mexico, Professor Marsh has found the first shadowy forerunner of my donkey-an equine quadruped which he has appropriately called cohippus, with five toes to each very vague progenitor of the horse family had begun to develop towards the distinctive peculiarity of his race -the solid hoof, adapted to free scouring over open grass-grown plains; early period, only in a rudimentary condition. In the higher eccenes of Wyoming and Utah, we get a rather more horse-like creature, orohippus, a big as a fox, with four toes to his front feet and three to his hind feet. Then, only about a million years or so later, in the miocene of Oregon and ized equine animals, michippus and which the middle one is distinctly the hippus, as big as this donkey, with one stout middle toe, much like our modern horse's hoof, and a lateral one on each side which does not reach to the ground. Side by side with these very horse-like forms occurs Here, we have all often been told, we

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nows the norse and peen disthe later Professor or us in he horses form of eir very or must mblance the pigs, me even nurs and st eocene r Marsh y foreequine priately to each ch fore ver, this e horse towards his race to free a plains; at this nentary enes of a rather hippus, s to his id feet. rs or so on and pecialis and), with eet, of ly the unner lorses. upon proto-, with ce our ateral reach with ccurs type, l toes olintecies. l, we

have probably preserved for us several | orease in intelligence and brain-power distinct steps in the evolution of our among all the mammalia from the mohorses and donkeys. One solid hoof ment of their first appearance upon on each foot gives unarmed herbivo- the earth till the present time. rous animals of their peculiar habits the best possible chance in the struggle from the very conditions of evolution. for life; and so towards the development of this one hoof they have been slowly verging ever since eocene times, by the gradual enlargement of the central toe, and the gradual sup-pression of all the rest. They have no horns like the bison and the bu.falo; but by their swiftness and sureness of foot wild horses are able easily to hold their own against all carnivorous enemies on the grassy pampas of South America, as zebras do on the great South African plateau, and onagers on the broad steppes of Central Asia.

Most people, however, do not know that pari passu with this develop-ment of a special form of hoof adapted to the free roaming existence of the horse tribe there has gone on a constant increase in the relative size and weight of the brain. Our comparative anatomists as a rule naturally attach most importance to the development of the bony skeleton, and especially of those parts which are most charact istic of families and genera. Psychology is a subject that interests them comparatively little. Hence we lay-readers are apt to get rather surfeited with descriptions of changes in the supra-condyloid foramen or the lateral ethmoid, about which the world at large is culpably indifferent: while we hear hardly anything as to the evidences of mental development, about which the world at large feels a much more genuine interest. As a matter of fact, in the pedigree of the horse and the donkey there is abundant proof of such pro-The brain of the evolving gress. horse tribe goes on increasing (as we judge from the skulls) with every advance in structure through tertiary times, not only absolutely as the whole avoid being an extremely clever brute. animal grows bigger, but relatively Not quite so clever, to be sure, as the also in proportion to the other parts. higher monkeys and the elephants;

Such an increase naturally results Not only the strongest and the physically best adapted have survived in the long run, but the cleverest and the shiftiest as well. All very early mammals, discovered sparsely in the secondary formations, have extremely small and ill-developed brains. All surviving isolated archaic forms, preserved in special and long insulated areas, far from the fierce competition of higher types, as is the case with the marsupials of Australia, the low lemuroid animals of Madagascar, and the edentates of South America, have brains hardly better than these primitive species. All ancient types which still linger on as burrowers or nocturnal prowlers in the great continents, like our own moles and shrews and hedgehogs, have also a very low grade of intelligence, and a very poorly developed brain; but, as we rise toward the summit of each great specialized and differentiated line of modern mammals, we find a constant increase in intelligence and brainpower, exactly analogous to that which we can trace historically in the horse tribe. The central and least developed forms, like the rodents and still more the insectivores, are comparatively stupid and helpless; but the highly adapted creatures which represent the final outcome of the main divergent branches—such as the ungulates, the carnivores, and the quadrumana-are all remarkable for their exceptional intelligence. Of these crowning species, the horse and the donkey stand at the head of their own line, just as man stands at the head of the quadrumana, or as the elephant and the tiger stand at the head of their special geneaological trees. So that the donkey really cannot well Indeed, there has been a regular in- for, as Mr. Herbert Spencer has

pointed out, the opposable thumb and that I am well rewarded for my pains; the highly mobile trunk with its tactile appendage give these creatures an exceptional chance of grasping an object all round, and so of thoroughly learning its physical properties, which has put them intellectually in the very front rank of the animal world; but in the earnivores, the ruminants, and the horse tribe, a very delicate sense of smell seems almost to make up for the want of a special grasping At any rate the leading organ. members of these groups-the cats, bears, eamels, deer, bison, horse, and donkey-are all of them conspicuous among their compeers for the relatively high quality of their intellectual gifts.

XX.

BESIDE THE CROMLECH.

On the long spur where the path loses itself among bracken and heather, just below the summit of around me on every hand; and in-Mynydd Mawr, I met an Ancient deed the bossed and rounded surface Briton, from whom I tried to learn the way to the cromlech. Unfortunately, my Ancient Briton, "had not the English," and so failed to comprehend the questions I put to him; but, by mustering all my stock of Welsh in a supreme effort, I managed at last to make him understand what it was that I wanted. "Oh, ay," he says, in his native Cymric, politely swallowing down his rising tive cromlech builders, in order roughsmile at my imperfect ll's and ch's. "You mean the Fairy's Grave. Cross past the llyn and up the ledge of Crib Goeh, and you'll find it on the very erest of Mynydd." I will not assert that I fully understood him in every word, but that was certainly the gist been erected a long way on the hither of his directions, eked out by a good side of the glacial epoch. There were deal of gesture and pantomime; and, at any rate, here I am at last, stretched and they have left their memorials in out at full length under the shadow of the rough chipped flint implements of the great monoliths and looking across the drift and on the hardened floors the bay, whitened by the foam of of caves; but every trace of their Sarn Badrig, to the long, clear-cut presence has of course been planed blue range of the Carnarvonshire off the actual surface of the country mountains. The sky is cloudless and by the great sheets of ice which, durthe horizon very free from mist, so ing the last glaciation, ground down

for I can see the whole peninsula from Snowdon on to Braich-y-Pwll rising and sinking in hill or lowland, and at the very end of all, Bardsey, the Isle of Bards, stands square and solid against the sky-line, with a solitary ship under full sail showing in the very centre of the sound, and the Irish Sea stretching away to southward, distinct and blue, as far as the eye can reach.

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The cromlech itself is a fine specimen of a megalithic structure, piled up of four large boulders from the neighboring hillside, and but little squared or hewn by artificial means. The boulders do not belong to the same Cambrian rock as the underlying hill; they are fragments of Snowdonian granite, transported hither by the glaciers of the great ice age, which seratched the grooves and furrows on the naked limestone of the mountain itself. I can trace these grooves all of all the shoulders would in itself suffice to suggest glacial action immediately to any geological eye. Similar markings occur on the sides of the three upright stones in the eromlech, and on the under front of the table-stone which lies across them; but here and there the original striated surface has been cut away by the rude tools of the primily to shape the irregular masses for their present position. For of course cromlechs, though very ancient from the historical point of view, are quite modern in the geological or even the anthropological estimate. They have men in Britain before the last ice age,

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e speeiiled up neigl.quared boulde Camg hill; donian by the which ows on untain ves all nd inurface itself n imeye. sides n the ont of leross origia ent)rimionghs for ourse from quite n the have ither were age, ıls in its of loors their aned ntry dur-

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VIGNETTES FROM NATURE.

find on the surface of the land, like this Welsh cromlech or the numerous barrows of our English downs, belong to a much later race, as one can see at once from the very fact that they are so often built up of glacial boulders. Indeed, the earlier preglacial men were mere hunting savages of the rudest type, wholly incapable of co-operation for works such as these; so that even if the ice had not swept away every trace of them, as it has now swept over the whole face of Greenland, we should still have few monuments of such early date save only the angular hatchets of the drift and the shapelier bone harpoons of the whale hunting cave-men.

Originally this cromlech must have been covered with a barrow. It formed, indeed, the central chamber of a neolithic tomb; and over it the earth was once heaped up in a great and conspicuous pile. In England, as a rule, the barrows still survive, especially in all the southeastern plain and the lesser hills or downs. But in Wales and Cornwall, and in the more mountainous regions generally, where soil is scanty and denuding agents act more rapidly, the barrows have oftener been washed away by rain or torrents or slowly crumbled down by sun and wind. That, no doubt, is partly the reason why people generally believe that ".Druidical remains," as they choose to call them, are specially frequent in these Keltic regions. It seems natural enough to suppose that ancient British monuments should be carefully preserved body safe from beasts or birds; and in such outlying spots as these where the Ancient Britons still survive in almost unmixed purity. But, as a dancing and sacrifice and human masmatter of fact, the cromlechs are sacres. Perhaps the wives and slaves really less preserved here than else- of the dead man were slain and where, because their barrows have buried with him, to attend him in the mostly been washed away, and the other world; perhaps the blood of body within has long since disap-human victims was poured over the peared. The best preserved crom- new-made grave as an offering to the lechs are, of course, those which you thirsty ghost. Sitting in this peacecannot see at all, because they are ful industrial nineteenth century on

the whole face of England into bare still covered with their inclosing undulating folds of naked rock. The mound of earth and still contain the prehistoric monuments which we now bones and relies of the dead man within them. It is the desecrated tomb that we call a Druidieal monument; the undescera ed we only describe as a prehistorie barrow.

> There can be very little doubt that this cromleeh, like all others, was once upon a time the tomb of an early chieftain. From the general character of its workmanship, and the very slight extent to which the stones have been dressed, I feel pretty confident that it must belong rather to the neolithic than to the bronze age. Hither, some day five thousand years sinceperhaps ten thousand for all that science can say-a crowd of brownskinned, short-statured tribesmen bore up the dead body of their chief from the village in the clearing on the little stream below. Here with wooden levers and round logs for rollers they toilfully brought together by sheer force of straining sinews these four great ice-worn boulders which lay scattered upon the slope around. On the crest of Mynydd Mawr they hewed them into rough symmetry, and built them into a rude imitation of the royal hut, first placing the three uprights in position, and then prising up the flat roofing-stone with their log rollers over an inclined plane of loose earth. In the hut thus formed they placed the dead body of their chief, with his weapons, his ornaments, and his household goods, that his ghost might eat, drink, and fight in the world of ghosts as it had done in the valley below. Then they piled up the great mound of earth above it to keep the around the fresh heap they performed I know not what barbarie orgies of

50 [501]

the dry heather under the shadow of | Professor Rhys has heard men taunted hardly realize what nameless horrors the descendants of fairies; that is to day when the neolithic dwellers in the the servile race; just as in America, the summit of Mynydd Mawr. think of them only under the soften- still be a term of insult to call a man ing and romantic influence of time; we look upon their lichen-covered in all popular tradition the fairies are surface through the tinged halo of poetical imagination; they are to us the hoary remnants of our forefathers' world, the titanic, archaic, immemorial temples of a forgotten creed. We do not remember how terrible and sickening were the realities of which these grey and yellow-stained granite bosses are the sole remaining vouch-Time has turned the relics of ers. some Dahomey custom into a pretty antiquated landmark and a romantic spot for holding a pienie.

Since then the rain has washed down every particle of soil that formerly covered the dead chieftain's grave. But still the memory of what it all are beginning to assume their au-once meant has lived on uninterrupt- tumnal tints. Down m the valley, it edly in the minds of the Ancient Britons around the spot. While the doctors of the eighteenth century were talking learned nonsense about Druidical temples and Arkite worship, the Welsh peasants of Mynydd Mawr were speaking correctly every day of the Fairy's Grave. For fairies and goblins and all such Keltic superstitions are mainly based upon stories about the ghosts of these neolithic people, whom the Keltic Welsh overcame and enslaved. But they would not touch the graves where lay the chieftains of the conquered folk, lest harm should come upon them for the desecration. Many of the neolithic people lived on as serfs under the Kelts, and much of their blood may be noted in the Llanfair villages at leaves. It is the fashion to say that the present day. The Briton who our English woodlands cannot comtold me the road here was himself, indeed, much more than an Ancient Briton; he was partly, at least, one of we look only at the general effect in the Ancientest Britons, a dark-haired, the two hemispheres the trite remark squat, brown-skinned man, of the reg- is true enough. ular long-headed Euskarian type. deniably one tree-the maple-whose

these picturesque old stones, one can even now at Carnarvon with being they may not have witnessed on the say, I take it, with being members of Llanfair valley first raised them above supposing blacks and whites to have We amalgamated for centuries, it might a nigger. When we remember that said to live inside green grass-grown hills, and that their names are always connected with the prehistoric neo lithic monuments of each particular district, a cromlech such as this, the Fairy's Grave, gains in our eyes a double interest. For while on the one-hand it is the undoubted burial place of a Euskarian chief, on the other hand it is the almost certain birth place of a Keltic fairy tradition.

XXI.

THE FALL OF THE LEFT.

ALREADY the trees on the hillside is true, beside the artificial water in the park, the oaks, the willows, and the ash trees are still quite green; but higher up among the slopes, where the wind beats harder and the nights even now begin to grow chilly, the limes and chestnuts have put on their first pale streaks of yellow, the beeches have turned in places to a rich brown, and the mountain ashes are faintly purpling against the glowing bunches of their scarlet berries. On all the deciduous trees, indeed, one can see that the living protoplasm is just beginning to withdraw from the foliage into the permanent tissues, leaving only those beautiful minor principles whose deficient vitality produces the lovely colors of Antumn pare in this respect with American or Canadian forests; and, no doubt, if America has unfol cli SOT gre len the

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hillside eir aulley, it ater in vs, and green : slopes, nd the chilly, out on w, the to a ashes glowerries. ideed. plasm from ssnes, minor tality tunn that coman or bt, if ct in nark unhose

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climate into graduated tints of crimson, scarlet, orange, yellow, and pale green, in a way that no European leaves have learned to imitate; and the maples are often adundant enough to give a general tone of brilliant coloring to an entire landscape such as we seldom see in our damper and mistier England. Besides, the change from Summer to Autumn comes on more rapidly there than with us: a few consecutive nights of dry, clear frost alter the whole face of nature, as if by magic, from green to gold and purple, in a fashion which would be impossible with our slow, longdrawn, changeable seasons. Yet, in spite of all this, I am not prepared to admit that even on the St. Lawrence or the Hudson you can often see anything more brilliant in its way than the yearly September display on our Thames about Nuneham and Pangbourne, or the Founder's Tower at Mag-Jalen, clad from pinnacle to base in uson Virginia creeper during [•] fortnight of October term. th Such outbursts of pure warm color are certainly rarer here than in America; but when once seen they enable one at least to realize, if my memory serves me right, what Canadian woodlands are like when the maples are set ablaze with red and orange in the mellow evenings of that causes, such as those suggested by too rare season, a successful Indian Dr. Croll and Mr. A. R. Wallace, Summer.

It is a curious phenomenon, this annual fall of all the leaves from almost all the trees in northern climates; and vet use has so dulled us to its strangeness that we seldom even think about its origin or meaning in any way. Indeed, until certain late investiga tions of the tertiary floras by M. Saporta, Mr. Starkie Gardiner, and others, it is doubtful whether anybody had ever asked himself any question upon the subject at all. But these investigations have shown pretty clearly that deciduous trees are quite fact itself remains certain that from a modern novelty upon our planet. the eocene age up to the giacial epoch things of the last two hundred mil- the climate of the earth grew steadily

foliage fades under that particular mense cooling of the earth's surface which began in the early tertiary period and culminated in the great glacial epoch. They are a special product of hard times at the Pole, like the white bears, the woolly rhinoceros, the mammoth and the snowbuntings. In the tropics all the trees are evergreens, or at least suffer no regular periodical loss of their foliage; but in the north we have few native evergreers except the pines and firs, with their needle-like leaves; and the two or three hardy, broadleaved exotic evergreens cultivated in our gardens or shrubberies, such as the rhododendrons, the laurels and the bay trees, together with our own smaller holly, box and privet, hardly suffice to convey a notion of the great sonthern forest trees, clad all the year round in thick green, such as the mangoes, the star-apples and the sandboxes. Up to the beginning of the tertiary period, however, large overgreens of what is now the tropical type, covered the whole of the world, as far as the very Poles themselves. Greenland and Spitzbergen then sup. ported huge forests of the same general character as those which now spread over Brazil and the Malay Archipelago. But from the first dawn of the eocene onward, some combination of astronomical and geographical began to produce a general chilling of the temperature at either Pole. Perhaps the effect was wholly due, as Dr. Croll believes, to the eccentricity of the earth's orbit and the precession of the equinoxes; perhaps it was further aided, as Mr. Wallace suggests, by the elevation of great mountain ranges about the polar regions, which became nurseries for immense glaciers, and so supplemented the natural chilling due to the cosmical cycles. At any rate, whatever theory we may adopt for its explanation, the lennia or so, entirely due to the im- colder, the change being of course

most marked at either Pole, and least of special empty cells, which are so noticeable in the equatorial district.

Concomitantly with the steady decrease of temperature thus forced upon the earth, a new forest vegetation developed itself in adaptation to the altered circumstances. This modern cold-weather flora of course first showed its face in the polar regions, or, to speak more correctly, about the North Pole. Here the fresh conditions first made themselves felt, and here all the familiar trees of modern English woodlands had their generie ori-In the eccene days the arctic gin. flora was still of a temperate or even sub-tropical aspect. But in the miocene age this temperate arctic flora was driven southward by the advancing cold, while a more strictly northern type of vegetation began to show itself among the hardy survivors which could accommodate themselves to the chillier winters of the new epoch. In the pliocene period, once more, the arctic miocene trees invaded northern and central Europe, and a still colder type appeared around Finally, with the pleistothe Poles. cene age, masses of ice began to occupy the North Pole itself, and drove even the hardiest and most arctic vegetation down to the Mediterranean basin, while England and half Germany were covered by the enormous sheet of permanent glaciers.

Now though the conifers, with their tough capillary leaves, did not suffer largely from the change, the evergreen tropical trees were clearly quite unfitted for conditions such as these. Their big leaves could do no serious work in the way of assimilating carbon from the atmosphere in the cold and gloom of northern winters; and the wind would only tear them off by thousands and waste the chlorophyll and starches laid up in their tissues. To meet this difficulty the modern deciduous oaks, ashes, and elms were developed. These trees do not merely allow their leaves to fall off with the wind, but they make actual provision present in the green leaf itself, though for such a contingency beforehand. completely masked during the period Each leaf-stalk is provided with a row of vigor by the preponderance of the

constructed that as soon as the leaves begin to die they rot away, and accordingly let the leaf fall readily, leaving a clean, dry scar, instead of waiting till some violent storm wrenches them off, tearing the living tissues and wasting the sap by bleeding. Moreover, when Autumn comes on, the living and utilizable material in each leaf is first withdrawn into the bark and branches, where it is stored up during the Winter in order to feed the young leaf-buds in the succeeding Spring; and then the row of specialized division-cells begins to warp, and lets the now useless skeleton of the blade drop off with the wind. Those large-leaved trees which thus learned to economize their stock of food stuffs were alone able to compete advantageously with the wiry and tough-skinned pines or furs; and thus many distinct families of forest trees, such as the maples, the oak and beech tribe, the elms, and the apple group, none of which are at all related to one another, have quite separately hit out the very same idea. Those which did not hit it out went to the wall; and indeed our existing northern forest flora represents, as it were, a mere fragment of the original northern vegetation-the few scattered species here and there among a vast number which managed to adapt themselves to the new and ungenial conditions of the northern zone.

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It is to this withdrawal of the green coloring matter and the other living principles from the dying leaves that we owe the tints of Autumn, as Mr. Sorby has carefully and minutely demonstrated. But it is a suggestive and striking fact that hues like these should exist always unseen in the very structure of the living plant, ready to be developed at any time by proper selective or accidental circumstances. Some of the colors are produced by the oxidation of the green chloro. phyll in person; others are actually natural pigment, which owes its color | trellis-work of the cottage, with its to a due admixture of them all. When we consider, however, that creepers are fast growing leafless colors like these lie ready and waiting among the windy hills of the north in the tissues of every plant, showing themselves wherever chlorophyll is not present in its most active form, alike in the young leaves or sprouting shoots of Spring and in the dying foliage of Autumn, it is easior to understand how the beautiful and brilliant petals of flowers have been developed by the selective action of insects. The red and orange and blue pigments were potentially there already; the insects' part was only to seize upon and favor them whenever special circumstances happened to bring them out into visible actuality.

XXII.

THE FALL OF THE YEAR.

UP on the downs to-day the view is dreary and gloomy enough. A grey mist hangs over the horizon to sea- to allow of the conditions under ward, while inland the hollow combes which alone life becomes possible. and rounded shoulders of the distant This pregnant idea has since been chalk range hardly stand out at all fully developed by later naturalists. through the foggy air. Sunlight Not only is it true that life as a whole throws "" their varied contour with must " we started at its first beginsplendid perspective depths of black ning nom the Pole, but we now shadow; but in dull wintry weather know that all fresh waves of fauna or like this, the outline merges into a flora must in like manner have set out single, unbroken leaden-blue line from the self-same point, and occuagainst the white background of the pied the earth by migration in circumsky. There can be no denying that polar zones. Moreover, the great chill October is really upon us. Yet centre of all life was in all probability even now a few patches of color still the North Pole alone, not the remain-some golden heads of the South; for, since Mr. autumnal hawkbit on the open, some luminous researches on the geostraggling bushes of the dwarf furze graphical distribution of animals, upon the glen-sides, and a mass of it has rich, foxy-brown bracken among the that our existing continents have been tumbled and uneven rockery of the steadily growing up for a vast period undercliff. The season is not quite of time, and that our existing oceans so far advanced here on the south have been oceans and nothing else coast as it was a few days since ever since the aqueous vapor of our among the dry, heather-clad hills and planet first condensed and cooled into yellow Autumn woods of North water. Hence it follows that the Wales. Every twenty miles south South Pole has always been isolated word tells at this season of the year, in the midst of an enormous stretch and so the passion-flowers are even of ocean, while the North Pole has now in blossom down here on the always been the point from which the

southerly aspect, while the trees and and the midlands.

It was Buffon, that half-unconscious predecessor of our modern evolutionists, who first pointed out the true importance of these zones of climate, from pole to equator, in the history of life upon the earth. For Buffon, with all his contempt for systematic classification and for accurate scientific knowledge, was a man of that wide philosophic grasp and that intuitive insight which are often more valuable after all than any amount of capacity for remembering dry detail; and he saw many points accordingly which were hidden from the wise and prudent artificial systematists of his time. Organic life, he remarked, must have begun at the Poles; for on the surface of an incandescent planet the Poles would be the first part to cool down sufficiently Wallace's become almost certain

are so e leaves and acreadily, lead of storm e living r bleed-1 comes naterial n into e it is n order the sucrow of ins to keleton wind. h thus ock of mpete y and ; and forest ak and apple at all quite ∋ idea. t went isting , as it iginal scatong a adapt zenial green iving s that s Mr. y destive these very dy to oper nces. d by loro ally ough

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great land masses of Europe, Asia, distantly like those of Java and Bra-Africa, and America have radiated zil, animals faintly suggesting those southward. In both hemispheres we of Central Africa and the Malay find the land widening out towards Archipelago, then formed the fauna the North Pole, but tapering away towards the South; and we know that just as the Poles had been the earliest South America and South Africa were till recently isolated outliers of their respective continents, while Australia remains an isolated outlier of Asia to the present day. Thus every great wave of animal or plant population must have set out always from perate again to aretie. And as life the North Pole, must have spread had first developed at the North Pole, southward in concentric circles, and thence to spread southward, so now must have but slowly reached the outlying southern extremities. Hence, generally speaking, we may expect to find the newest and most modern types in the great northern continents, and the oldest and most archaic concentric rings, so that the arctic types in the tapering southern peninsulas and islands.

The fact is, however, it is now Autumn with the whole of our planet, and the last great cold spell from which the northern hemisphere suffered-the glacial epoch-has somewhat interfered with the literal truth of this rough generalization. Climatically speaking, our earth has seen its modern and most highly evolved best day. We are now growing colder from age to age, and we may look forward in the distant future to an absolute Winter extending over the whole globe, when its surfaee will be as dead and changeless as that of the moon actually is before our own eyes. Life, indeed, viewed cosmically, is but a superficial phenomenon produced by arrested solar radiation on the outer crust of a cooling nebula, and it will disappear some day, from this earth at least, amid the universal chilling of an exhausted world. Luckily for us, however-or unluckily if the pessimists will have it so-the Winter has not so lin, New York and Chicago. During far really set in, and we are as yet that interval all living things were only at the premonitary stage of full necessarily driven towards the sub-Autumn. astronomers and geologists reekon dis- the middle of the earth thus became tance or nearness, when the Poles for a while the seat of the richest and were warm enough to support a thor- most advanced fauna and flora. Some

and flora of the extreme north. But part to cool from incandescence into a firm crust, so, when worse times came, they were the earliest part to cool from tropical heat to what we European human beings complacently describe as temperate, and from temthe new types of life, adapted to the altered conditions, were each first evolved at the North Pole, and were each pushed southward one after another, as the cold grew intenser, in fauna in one age becomes the parent of the North European fauna in the next age, of the Mediterranean fauna in the succeeding one, and of the Southern fauna in the epoch after that again. So long as life remained possible at the Pole at all, it was almost absolutely true that the polar plants and animals represented the most types at that moment living upon earth. Spitzbergen, in fact, then led the very van of progressive evolution. si

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But since the planetary Autumn has thoroughly set in, this principle has ceased to be quite true, and has been to some extent reversed by the occurrence of that great premature cold spell, the glacial epoch. Towards the close of the tertiary period, a combination of astronomical and geological causes set up a long interval of intense eold in the northern hemisphere, which made all life impossible, not only at the Pole itself, but even as far south as London, Ber-The time is still recent, as tropical and equatorial regions; and cughly tropical type of life. Trees seventy or eighty thousand years

and Brang those e Malay he fanna th. But e earliest ence into rse times t part to what we placently rom teml as life rth Pole, , so now d to the tch first and were ne after enser, in e arctic e parent in the m fanna of the fter that ned poss almost r plants e most evolved g upon then led olution. Antumn rinciple nd has by the mature 1. Toperiod, al and r interorthern ife imitself, n, Ber-During s were e sub-; and ecame st and Some years

backed by the almost unanimous district of Sahara. Hence it is only opinion of the greatest scientific au-|in America that the fauna and flora thorities, these unfavorable astronom- have been free to make their way ical conditions ended, and the vast back, unimpeded, from Carolina and glacial sheet cleared away from the face of the northern hemisphere, at Lawrence basin. Even here, the releast below the latitude of Greenland. But, as Mr. Wallace believes, the ge- while in isolated portions of Europe, ological conditions remained unal-like Great Britain, and still more tered; and so, instead of the Pole markedly Ireland, where the fauna becoming once more habitable, it still and flora had hardly time to penecontinues to be enveloped in perpet- trate before the submergence which ual snow. From that time forward turned them into islands, the comparthe exiled plants and animals, which ative poverty of life is very noticehad been driven south by the ad-able. Nevertheless, the temperate vancing cold, have begun to migrate types have everywhere driven out the northward once more and to re-occu-polar species which preceded them, py the deserted plains of temperate except on the very summits of the Asia and America.

the conditions have been unfavorable peak in the Eastern States, there linto their rapid northward progress. In ger even now some few butterflies of Asia, the great central region is occu-a species which is not found again pied by the snowy mountain ranges till we reach the arctic regions. of the Himalayas and the Hindu Their ancestors were stranded there Thibet, which cut off the cold Sibe- rest of their kind were driven northflora of the Indian region; in Europe, been able to hold their own against similarly divide us from Africa, which which came to occupy the surroundis itself cut almost in two, biologically ing country.

since, if we may trust Dr. Croll, speaking, by the practically lifeless Georgia to New England and the St. peopling has been far from complete: principal mountains. Near the top In the eastern hemisphere, however, of Mount Washington, the highest Kush, and by the high table land of by the receding glaciers, when all the rian plains from the rich fauna and wards; and there alone they have the Mediterranean and the Caucasus the better adapted southern kinds

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