ALLEN GRANT

SCIENCE IN ARCADY

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Содержание

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PREFACE

These essays deal for the most part with Science in Arcady. 'Tis my native country: for I am not of those who 'praise the busy town.' On the contrary, in the words of the great poet who has just departed to join Milton and Shelley in a place of high collateral glory, I 'love to rail against it still,' with a naturalist's bitterness. For the town is always dead and lifeless. There are who admire it, they say—poor purblind creatures—because, forsooth, 'there is so much life there.' So much life, indeed! No grass in the streets; no flowers in the lanes; no beetles or butterflies on the dull stone pavements! Brick and mortar have killed out all life over square miles of Middlesex. For myself, I love better the densely-peopled fields than this human desert, this beflagged and macadamised man-made solitude. The country teems with life on every hand; a thousand different plants and flowers in the spangled meadows; a thousand varied denizens of pond, and air, and heath, and copses. Their ways are endless. They attract me far more with their infinite diversity than the grey and gloomy haunts of the cab-horse and the stock-broker.

But my Arcady, as you will see, is none the less tolerably

broad and eclectic in its limits. These various essays have been suggested to my pen by rambles far and wide between its elastic confines. The little tractate on *Mud*, for example, recalls to mind some pleasant weeks among the Italian lakes and on the plain of Lombardy. *A Desert Fruit* owes its origin to a morning at Luxor. *High Life* had its key-note struck by a fortnight in the Tyrol. *Tropical Education* is a dim reminiscence of old Jamaican experiences. Our *Eight-Legged Friends* were observed at leisure on the window-panes of our own little nook at Dorking. *A Hill-Top Stronghold* was sketched *in situ* at Florence by a window that looked across the valley to Fiesole. Excursions into books or into the remoter past have given occasion for the archæological essays relegated here to the end of the volume.

My thanks are due to Messrs. Longmans for permission to reprint from their magazine *My Islands*, *A Hill-Top Stronghold*, *A Desert Fruit*, *The Isle of Ruim*, *Eight-Legged Friends*, and *Tropical Education*. I have also to acknowledge a similar courtesy on the part of Messrs. Smith & Elder with regard to *Mud*, *The Bronze Axe*, *High Life*, *Pretty Poll*, *The Greenwood Tree*, *On the Wings of the Wind*, *Casters and Chesters*, and *Fish as Fathers*, all of which originally appeared in the *Cornhill*. Messrs. Chatto & Windus have been equally kind as regards the paper on *An English Shire* contributed to the *Gentleman's*. *A Persistent Nationality* made its first bow in the *North American Review*, and has still to be introduced to an English audience.

G.A.

Hind Head, Surrey,
Oct., 1892.

MY ISLANDS

About the middle of the Miocene period, as well as I can now remember (for I made no note of the precise date at the moment), my islands first appeared above the stormy sheet of the North-West Atlantic as a little rising group of mountain tops, capping a broad boss of submarine volcanoes. My attention was originally called to the new archipelago by a brother investigator of my own aerial race, who pointed out to me on the wing that at a spot some 900 miles to the west of the Portuguese coast, just opposite the place where your mushroom city of Lisbon now stands, the water of the ocean, as seen in a bird's-eye view from some three thousand feet above, formed a distinct greenish patch such as always betokens shoals or rising ground at the bottom. Flying out at once to the point he indicated, and poising myself above it on my broad pinions at a giddy altitude, I saw at a glance that my friend was quite right. Land making was in progress. A volcanic upheaval was taking place on the bed of the sea. A new island group was being forced right up by lateral pressure or internal energies from a depth of at least two thousand fathoms.

I had always had a great liking for the study of material plants and animals, and I was so much interested in the occurrence of this novel phenomenon—the growth and development of an oceanic island before my very eyes—that I determined to devote the next few thousand centuries or so of my æonian existence to

watching the course of its gradual evolution.

If I trusted to unaided memory, however, for my dates and facts, I might perhaps at this distance of time be uncertain whether the moment was really what I have roughly given, within a geological age or two, the period of the Mid-Miocene. But existing remains on one of the islands constituting my group (now called in your new-fangled terminology Santa Maria) help me to fix with comparative certainty the precise epoch of their original upheaval. For these remains, still in evidence on the spot, consist of a few small marine deposits of Upper Miocene age; and I recollect distinctly that after the main group had been for some time raised above the surface of the ocean, and after sand and streams had formed a small sedimentary deposit containing Upper Miocene fossils beneath the shoal water surrounding the main group, a slight change of level occurred, during which this minor island was pushed up with the Miocene deposits on its shoulders, as a sort of natural memorandum to assist my random scientific recollections. With that solitary exception, however, the entire group remains essentially volcanic in its composition, exactly as it was when I first saw its youthful craters and its red-hot ash-cones pushed gradually up, century after century, from the deep blue waters of the Mid-Miocene ocean.

All round my islands the Atlantic then, as now, had a depth, as I said before, of two thousand fathoms; indeed, in some parts between the group and Portugal the plummet of your human navigators finds no bottom, I have often heard them say, till it

reaches 2,500; and out of this profound sea-bed the volcanic energies pushed up my islands as a small submarine mountain range, whose topmost summits alone stood out bit by bit above the level of the surrounding sea. One of them, the most abrupt and cone-like, by name now Pico, rises to this day, a magnificent sight, sheer seven thousand feet into the sky from the placid sheet that girds it round on every side. You creatures of to-day, approaching it in one of your clumsy new-fashioned fire-driven canoes that you call steamers, must admire immensely its conical peak, as it stands out silhouetted against the glowing horizon in the deep red glare of a sub-tropical Atlantic sunset.

But when I, from my solitary aerial perch, saw my islands rise bare and massive first from the water's edge, the earliest idea that occurred to me as an investigator of nature was simply this: how will they ever get clad with soil and herbage and living creatures? So naked and barren were their black crags and rocks of volcanic slag, that I could hardly conceive how they could ever come to resemble the other smiling oceanic islands which I looked down upon in my flight from day to day over so many wide and scattered oceans. I set myself to watch, accordingly, whence they would derive the first seeds of life, and what changes would take place under dint of time upon their desolate surface.

For a long epoch, while the mountains were still rising in their active volcanic state, I saw but little evidence of a marked sort of the growth of living creatures upon their loose piles of pumice. Gradually, however, I observed that spores of lichens,

blown towards them by the wind, were beginning to sprout upon the more settled rocks, and to discolour the surface in places with grey and yellow patches. Bit by bit, as rain fell upon the new-born hills, it brought down from their weathered summits sand and mud, which the torrents ground small and deposited in little hollows in the valleys; and at last something like earth was found at certain spots, on which seeds, if there had been any, might doubtless have rooted and flourished exceedingly.

My primitive idea, as I watched my islands in this their almost lifeless condition, was that the Gulf Stream and the trade winds from America would bring the earliest higher plants and animals to our shores. But in this I soon found I was quite mistaken. The distance to be traversed was so great, and the current so slow, that the few seeds or germs of American species cast up upon the shore from time to time were mostly far too old and water-logged to show signs of life in such ungenial conditions. It was from the nearer coasts of Europe, on the contrary, that our earliest colonists seemed to come. Though the prevalent winds set from the west, more violent storms reached us occasionally from the eastward direction; and these, blowing from Europe, which lay so much closer to our group, were far more likely to bring with them by waves or wind some waifs and strays of the European fauna and flora.

I well remember the first of these great storms that produced any distinct impression on my islands. The plants that followed in its wake were a few small ferns, whose light spores were more

readily carried on the breeze than any regular seeds of flowering plants. For a month or two nothing very marked occurred in the way of change, but slowly the spores rooted, and soon produced a small crop of ferns, which, finding the ground unoccupied, spread when once fairly started with extraordinary rapidity, till they covered all the suitable positions throughout the islands.

For the most part, however, additions to the flora, and still more to the fauna, were very gradually made; so much so that most of the species now found in the group did not arrive there till after the end of the Glacial epoch, and belong essentially to the modern European assemblage of plants and animals. This was partly because the islands themselves were surrounded by pack-ice during that chilly period, which interrupted for a time the course of my experiment. It was interesting, too, after the ice cleared away, to note what kinds could manage by stray accidents to cross the ocean with a fair chance of sprouting or hatching out on the new soil, and which were totally unable by original constitution to survive the ordeal of immersion in the sea. For instance, I looked anxiously at first for the arrival of some casual acorn or some floating filbert, which might stock my islands with waving greenery of oaks and hazel bushes. But I gradually discovered, in the course of a few centuries, that these heavy nuts never floated securely so far as the outskirts of my little archipelago; and that consequently no chestnuts, apple trees, beeches, alders, larches, or pines ever came to diversify my island valleys. The seeds that did really reach us from time to time

belonged rather to one or other of four special classes. Either they were very small and light, like the spores of ferns, fungi, and club-mosses; or they were winged and feathery, like dandelion and thistle-down; or they were the stones of fruits that are eaten by birds, like rose-hips and hawthorn; or they were chaffy grains, enclosed in papery scales, like grasses and sedges, of a kind well adapted to be readily borne on the surface of the water. In all these ways new plants did really get wafted by slow degrees to the islands; and if they were of kinds adapted to the climate they grew and flourished, living down the first growth of ferns and flowerless herbs in the rich valleys.

The time which it took to people my archipelago with these various plants was, of course, when judged by your human standards, immensely long, as often the group received only a single new addition in the lapse of two or three centuries. But I noticed one very curious result of this haphazard and lengthy mode of stocking the country: some of the plants which arrived the earliest, having the coast all clear to themselves, free from the fierce competition to which they had always been exposed on the mainland of Europe, began to sport a great deal in various directions, and being acted upon here by new conditions, soon assumed under stress of natural selection totally distinct specific forms. (You see, I have quite mastered your best modern scientific vocabulary.) For instance, there were at first no insects of any sort on the islands; and so those plants which in Europe depended for their fertilisation upon bees or butterflies had here

either to adapt themselves somehow to the wind as a carrier of their pollen or else to die out for want of crossing. Again, the number of enemies being reduced to a minimum, these early plants tended to lose various defences or protections they had acquired on the mainland against slugs or ants, and so to become different in a corresponding degree from their European ancestors. The consequence was that by the time you men first discovered the archipelago no fewer than forty kinds of plants had so far diverged from the parent forms in Europe or elsewhere that your savants considered them at once as distinct species, and set them down at first as indigenous creations. It amused me immensely.

For out of these forty plants thirty-four were to my certain knowledge of European origin. I had seen their seeds brought over by the wind or waves, and I had watched them gradually altering under stress of the new conditions into fresh varieties, which in process of time became distinct species. Two of the oldest were flowers of the dandelion and daisy group, provided with feathery seeds which enable them to fly far before the carrying breeze; and these two underwent such profound modifications in their insular home that the systematic botanists who at last examined them insisted upon putting each into a new genus, all by itself, invented for the special purpose of their reception. One almost equally ancient inhabitant, a sort of harebell, also became in process of time extremely unlike any other harebell I had ever seen in any part of my airy

wanderings. But the remaining thirty new species or so evolved in the islands by the special circumstances of the group had varied so comparatively little from their primitive European ancestors, that they hardly deserved to be called anything more than very distinct and divergent varieties.

Some five or six plants, however, I noted arrive in my archipelago, not from Europe, but from the Canaries or Madeira, whose distant blue peaks lay dim on the horizon far to the south-west of us, as I poised in mid-air high above the topmost pinnacle of my wild craggy Pico. These kinds, belonging to a much warmer region, soon, as I noticed, underwent considerable modification in our cooler climate, and were all of them adjudged distinct species by the learned gentlemen who finally reported upon my island realm to British science.

As far as I can recollect, then, the total number of flowering plants I noted in the islands before the arrival of man was about 200; and of these, as I said before, only forty had so far altered in type as to be considered at present peculiar to the archipelago. The remainder were either comparatively recent arrivals or else had found the conditions of their new home so like those of the old one from which they migrated, that comparatively little change took place in their forms or habits. Of course, just in proportion as the islands got stocked I noticed that the changes were less and less marked; for each new plant, insect, or bird that established itself successfully tended to make the balance of nature more similar to the one that obtained in the mainland

opposite, and so decreased the chances of novelty of variation.

Hence, it struck me that the oldest arrivals were the ones which altered most in adaptation to the circumstances, while the newest, finding themselves in comparatively familiar surroundings, had less occasion to be selected for strange and curious freaks or sports of form or colour.

The peopling of the islands with birds and animals, however, was to me even a more interesting and engrossing study in natural evolution than its peopling by plants, shrubs, and trees. I may as well begin, therefore, by telling you at once that no furry or hairy quadruped of any sort—no mammal, as I understand your men of science call them—was ever stranded alive upon the shores of my islands. For twenty or thirty centuries indeed, I waited patiently, examining every piece of driftwood cast up upon our beaches, in the faint hope that perhaps some tiny mouse or shrew or water-vole might lurk half drowned in some cranny or crevice of the bark or trunk. But it was all in vain. I ought to have known beforehand that terrestrial animals of the higher types never by any chance reach an oceanic island in any part of this planet. The only three specimens of mammals I ever saw tossed up on the beach were two drowned mice and an unhappy squirrel, all as dead as doornails, and horribly mauled by the sea and the breakers. Nor did we ever get a snake, a lizard, a frog, or a fresh-water fish, whose eggs I at first fondly supposed might occasionally be transported to us on bits of floating trees or matted turf, torn by floods from those prehistoric Lusitanian

or African forests. No such luck was ours. Not a single terrestrial vertebrate of any sort appeared upon our shores before the advent of man with his domestic animals, who played havoc at once with my interesting experiment.

It was quite otherwise with the unobtrusive small deer of life—the snails, and beetles, and flies, and earthworms—and especially with the winged things: birds, bats, and butterflies. In the very earliest days of my islands' existence, indeed, a few stray feathered fowls of the air were driven ashore here by violent storms, at a time when vegetation had not yet begun to clothe the naked pumice and volcanic rock; but these, of course, perished for want of food, as did also a few later arrivals, who came under stress of weather at the period when only ferns, lichens, and mosses had as yet obtained a foothold on the young archipelago. Sea-birds, of course, soon found out our rocks; but as they live off fish only, they contributed little more than rich beds of guano to the permanent colonising of the islands. As well as I can remember, the land-snails were the earliest truly terrestrial casuals that managed to pick up a stray livelihood in these first colonial days of the archipelago. They came oftenest in the egg, sometimes clinging to water-logged leaves cast up by storms, sometimes hidden in the bark of floating driftwood, and sometimes swimming free on the open ocean. In one case, as I recall to myself well, a swallow, driven off from the Portuguese coast, a little before the Glacial period had begun to whiten the distant mountains of central and northern Europe, fell exhausted

at last upon the shore of Terceira. There were no insects then for the poor bird to feed upon, so it died of starvation and weariness before the day was out; but a little earth that clung in a pellet to one of its feet contained the egg of a land-shell, while the prickly seed of a common Spanish plant was entangled among the winged feathers by its hooked awns. The egg hatched out, and became the parent of a large brood of minute snails, which, outliving the cold spell of the Ice Age, had developed into a very distinct type in the long period that intervened before the advent of man in the islands; while the seed sprang up on the natural manure heap afforded by the swallow's decaying body, and clinging to the valleys during the Glacial Age on the hill-tops, gave birth in due season to one of the most markedly indigenous of our Terceira plants.

Occasionally, too, very minute land-snails would arrive alive on the island after their long sea-voyage on bits of broken forest-trees—a circumstance which I would perhaps hesitate to mention in mere human society were it not that I have been credibly informed your own great naturalist, Darwin, tried the experiment himself with one of the biggest European land-molluscs, the great edible Roman snail, and found that it still lived on in vigorous style after immersion in sea-water for twenty days. Now, I myself observed that several of these bits of broken trees, torn down by floods in heavy storm time from the banks of Spanish or Portuguese rivers, reached my island in eight or ten days after leaving the mainland, and sometimes contained

eggs of small land-snails. But as very long periods often passed without a single new species being introduced into the group, any kind that once managed to establish itself on any of the islands usually remained for ages undisturbed by new arrivals, and so had plenty of opportunity to adapt itself perfectly by natural selection to the new conditions. The consequence was, that out of some seventy land-snails now known in the islands, thirty-two had assumed distinct specific features before the advent of man, while thirty-seven (many of which, I think, I never noticed till the introduction of cultivated plants) are common to my group with Europe or with the other Atlantic islands. Most of these, I believe, came in with man and his disconcerting agriculture.

As to the pond and river snails, so far as I could observe, they mostly reached us later, being conveyed in the egg on the feet of stray waders or water-birds, which gradually peopled the island after the Glacial epoch.

Birds and all other flying creatures are now very abundant in all the islands; but I could tell you some curious and interesting facts, too, as to the mode of their arrival and the vicissitudes of their settlement. For example, during the age of the Forest Beds in Europe, a stray bullfinch was driven out to sea by a violent storm, and perched at last on a bush at Fayal. I wondered at first whether he would effect a settlement. But at that time no seeds or fruits fit for bullfinches to eat existed on the islands. Still, as it turned out, this particular bullfinch happened to have in his crop several undigested seeds of European plants exactly

suited to the bullfinch taste; so when he died on the spot, these seeds, germinating abundantly, gave rise to a whole valleyful of appropriate plants for bullfinches to feed upon. Now, however, there was no bullfinch to eat them. For a long time, indeed, no other bullfinches arrived at my archipelago. Once, to be sure, a few hundred years later, a single cock bird did reach the island alone, much exhausted with his journey, and managed to pick up a living for himself off the seeds introduced by his unhappy predecessor. But as he had no mate, he died at last, as your lawyers would say, without issue.

It was a couple of hundred years or so more before I saw a third bullfinch—which didn't surprise me, for bullfinches are very woodland birds, and non-migratory into the bargain—so that they didn't often get blown seaward over the broad Atlantic. At the end of that time, however, I observed one morning a pair of finches, after a heavy storm, drying their poor battered wings upon a shrub in one of the islands. From this solitary pair a new race sprang up, which developed after a time, as I imagined they must, into a distinct species. These local bullfinches now form the only birds peculiar to the islands; and the reason is one well divined by one of your own great naturalists (to whom I mean before I end to make the *amende honorable*). In almost all other cases the birds kept getting reinforced from time to time by others of their kind blown out to sea accidentally—for only such species were likely to arrive there—and this kept up the purity of the original race, by ensuring a cross every now and again with

the European community. But the bullfinches, being the merest casuals, never again to my knowledge were reinforced from the mainland, and so they have produced at last a special island type, exactly adapted to the peculiarities of their new habitat.

You see, there was hardly ever a big storm on land that didn't bring at least one or two new birds of some sort or other to the islands. Naturally, too, the newcomers landed always on the first shore they could sight; and so at the present day the greatest number of species is found on the two easternmost islands nearest the mainland, which have forty kinds of land-birds, while the central islands have but thirty-six, and the western only twenty-nine. It would have been quite different, of course, if the birds came mainly from America with the trade winds and the Gulf Stream, as I at first anticipated. In that case, there would have been most kinds in the westernmost islands, and fewest stragglers in the far eastern. But your own naturalists have rightly seen that the existing distribution necessarily implies the opposite explanation.

Birds, I early noticed, are always great carriers of fruit-seeds, because they eat the berries, but don't digest the hard little stones within. It was in that way, I fancy, that the Portugal laurel first came to my islands, because it has an edible fruit with a very hard seed; and the same reason must account for the presence of the myrtle, with its small blue berry; the laurustinus with its currant-like fruit; the elder-tree, the canary laurel, the local sweet-gale, and the peculiar juniper. Before these shrubs were introduced

thus unconsciously by our feathered guests, there were no fruits on which berry-eating birds could live; but now they are the only native trees or large bushes on the islands—I mean the only ones not directly planted by you mischief-making men, who have entirely spoilt my nice little experiment.

It was much the same with the history of some among the birds themselves. Not a few birds of prey, for example, were driven to my little archipelago by stress of weather in its very early days; but they all perished for want of sufficient small quarry to make a living out of. As soon, however, as the islands had got well stocked with robins, black-caps, wrens, and wagtails, of European types—as soon as the chaffinches had established themselves on the seaward plains, and the canary had learnt to nest without fear among the Portugal laurels—then buzzards, long-eared owls, and common barn-owls, driven westward by tempests, began to pick up a decent living on all the islands, and have ever since been permanent residents, to the immense terror and discomfort of our smaller song-birds. Thus the older the archipelago got the less chance was there of local variation taking place to any large degree, because the balance of life each day grew more closely to resemble that which each species had left behind it in its native European or African mainland.

I said a little while ago we had no mammal in the islands. In that I was not quite strictly correct. I ought to have said, no terrestrial mammal. A little Spanish bat got blown to us once by a rough nor'easter, and took up its abode at once among the

caves of our archipelago, where it hawks to this day after our flies and beetles. This seemed to me to show very conspicuously the advantage which winged animals have in the matter of cosmopolitan dispersion; for while it was quite impossible for rats, mice, or squirrels to cross the intervening belt of three hundred leagues of sea, their little winged relation, the flitter-mouse, made the journey across quite safely on his own leathery vans, and with no greater difficulty than a swallow or a wood-pigeon.

The insects of my archipelago tell very much the same story as the birds and the plants. Here, too, winged species have stood at a great advantage. To be sure, the earliest butterflies and bees that arrived in the fern-clad period were starved for want of honey; but as soon as the valleys began to be thickly tangled with composites, harebells, and sweet-scented myrtle bushes, these nectar-eating insects established themselves successfully, and kept their breed true by occasional crosses with fresh arrivals blown to sea afterwards. The development of the beetles I watched with far greater interest, as they assumed fresh forms much more rapidly under their new conditions of restricted food and limited enemies. Many kinds I observed which came originally from Europe, sometimes in the larval state, sometimes in the egg, and sometimes flying as full-grown insects before the blast of the angry tempest. Several of these changed their features rapidly after their arrival in the islands, producing at first divergent varieties, and finally, by dint of selection, acting

in various ways, through climate, food, or enemies, on these nascent forms, evolving into stable and well-adapted species. But I noticed three cases where bits of driftwood thrown up from South America on the western coasts contained the eggs or larvae of American beetles, while several others were driven ashore from the Canaries or Madeira; and in one instance even a small insect, belonging to a type now confined to Madagascar, found its way safely by sea to this remote spot, where, being a female with eggs, it succeeded in establishing a flourishing colony. I believe, however, that at the time of its arrival it still existed on the African continent, but becoming extinct there under stress of competition with higher forms, it now survives only in these two widely separated insular areas.

It was an endless amusement to me during those long centuries, while I devoted myself entirely to the task of watching my fauna and flora develop itself, to look out from day to day for any chance arrival by wind or waves, and to follow the course of its subsequent vicissitudes and evolution. In a great many cases, especially at first, the new-comer found no niche ready for it in the established order of things on the islands, and was fain at last, after a hard struggle, to retire for ever from the unequal contest. But often enough, too, he made a gallant fight for it, and, adapting himself rapidly to his new environment, changed his form and habits with surprising facility. For natural selection, I found, is a hard schoolmaster. If you happen to fit your place in the world, you live and thrive, but if you don't happen to fit it, to the wall

with you without quarter. Thus sometimes I would see a small canary beetle quickly take to new food and new modes of life on my islands under my very eyes, so that in a century or so I judged him myself worthy of the distinction of a separate species; while in another case, I remember, a south European weevil evolved before long into something so wholly different from his former self that a systematic entomologist would have been forced to enrol him in a distinct genus. I often wish now that I had kept a regular collection of all the intermediate forms, to present as an illustrative series to one of your human museums; but in those days, of course, we none of us imagined anybody but ourselves would ever take an interest in these problems of the development of life, and we let the chance slide till it was too late to recover it.

Naturally, during all these ages changes of other sorts were going on in my islands—elevations and subsidences, separations and reunions, which helped to modify the life of the group considerably. Indeed, volcanic action was constantly at work altering the shapes and sizes of the different rocky mountain-tops, and bringing now one, now another, into closer relations than before with its neighbours. Why, as recently as 1811 (a date which is so fresh in my memory that I could hardly forget it) a new island was suddenly formed by submarine eruption off the coast of St. Michael's, to which the name of Sabrina was momentarily given by your human geographers. It was about a mile around and 300 feet high; but, consisting as it did of loose cinders only, it was soon washed away by the force of the waves

in that stormy region. I merely mention it here to show how recently volcanic changes have taken place in my islands, and how continuously the internal energy has been at work modifying and re-arranging them.

Up to the moment of the arrival of man in the archipelago the whole population, animal and vegetable, consisted entirely of these waifs and strays, blown out to sea from Europe or Africa, and modified more or less on the spot in accordance with the varying needs of their new home. But the advent of the obtrusive human species spoilt the game at once for an independent observer. Man immediately introduced oranges, bananas, sweet potatoes, grapes, plums, almonds, and many other trees or shrubs, in which, for selfish reasons, he was personally interested. At the same time he quite unconsciously and unintentionally stocked the islands with a fine vigorous crop of European weeds, so that the number of kinds of flowering plants included in the modern flora of my little archipelago exceeds, I think, by fully one-half that which I remember before the date of the Portuguese occupation. In the same way, besides his domestic animals, this spoil-sport colonist man brought in his train accidentally rabbits, weasels, mice, and rats, which now abound in many parts of the group, so that the islands have now in effect a wild mammalian fauna. What is more odd, a small lizard has also got about in the walls—not as you would imagine, a native-born Portuguese subject, but of a kind found only in Madeira and Teneriffe, and, as far as I could make out at the time,

it seemed to me to come over with cuttings of Madeira vines for planting at St. Michael's. It was about the same time, I imagine, that eels and gold-fish first got loose from glass globes into the ponds and water-courses.

I have forgotten to mention, what you will no doubt yourself long since have inferred, that my archipelago is known among human beings in modern times as the Azores; and also that traces of all these curious facts of introduction and modification, which I have detailed here in their historical order, may still be detected by an acute observer and reasoner in the existing condition of the fauna and flora. Indeed, one of your own countrymen, Mr. Goodman, has collected all the most salient of these facts in his 'Natural History of the Azores,' and another of your distinguished men of science, Mr. Alfred Russel Wallace, has given essentially the same explanations beforehand as those which I have here ventured to lay, from another point of view, before a critical human audience. But while Mr. Wallace has arrived at them by a process of arguing backward from existing facts to prior causes and probable antecedents, it occurred to me, who had enjoyed such exceptional opportunities of watching the whole process unfold itself from the very beginning, that a strictly historical account of how I had seen it come about, step after step, might possess for some of you a greater direct interest than Mr. Wallace's inferential solution of the self-same problem. If, through lapse of memory or inattention to detail at so remote a period, I have set down aught amiss, I sincerely trust you will be

kind enough to forgive me. But this little epic of the peopling of a single oceanic archipelago by casual strays, which I alone have had the good fortune to follow through all its episodes, seemed to me too unique and valuable a chapter in the annals of life to be withheld entirely from the scientific world of your eager, ephemeral, nineteenth century humanity.

TROPICAL EDUCATION

If any one were to ask me (which is highly unlikely) 'In what university would an intelligent young man do best to study?' I think I should be very much inclined indeed to answer offhand, 'In the Tropics.'

No doubt this advice sounds on first hearing just a trifle paradoxical; and no doubt, too, the proposed university has certain serious drawbacks (like many others) on the various grounds of health, expense, faith, and morals. Senior Proctors are unknown at Honolulu; Select Preachers don't range as far as the West Coast. But it has always seemed to me, nevertheless, that certain elements of a liberal education are to be acquired tropically which can never be acquired in a temperate, still less in an arctic or antarctic academy. This is more especially true, I allow, in the particular cases of the biologist and the sociologist; but it is also true in a somewhat less degree of the mere common arts course, and the mere average seeker after liberal culture. Vast aspects of nature and human life exist which can never adequately be understood aright except in tropical countries; vivid side-lights are cast upon our own history and the history of our globe which can never adequately be appreciated except beneath the searching and all too garish rays of a tropical sun.

Whenever I meet a cultivated man who knows his Tropics—and more particularly one who has known his Tropics during the

formative period of mental development, say from eighteen to thirty—I feel instinctively that he possesses certain keys of man and nature, certain clues to the problems of the world we live in, not possessed in anything like the same degree by the mere average annual output of Oxford or of Heidelberg. I feel that we talk like Freemasons together—we of the Higher Brotherhood who have worshipped the sun, *præsentiorem deum*, in his own nearer temples.

Let me begin by positing an extreme parallel. How obviously inadequate is the conception of life enjoyed by the ordinary Laplander or the most intelligent Fuegian! Suppose even he has attended the mission school of his native village, and become learned there in all the learning of the Egyptians, up to the extreme level of the sixth standard, yet how feeble must be his idea of the planet on which he moves! How much must his horizon be cabined, cribbed, confined by the frost and snow, the gloom and poverty, of the bare land around him! He lives in a dark cold world of scrubby vegetation and scant animal life: a world where human existence is necessarily preserved only by ceaseless labour and at severe odds; a world out of which all the noblest and most beautiful living creatures have been ruthlessly pressed; a world where nothing great has been or can be; a world doomed by its mere physical conditions to eternal poverty, discomfort, and squalor. For green fields he has snow and reindeer moss: for singing birds and flowers, the ptarmigan and the tundra. How can he ever form any fitting

conception of the glory of life—of the means by which animal and vegetable organisms first grew and flourished? How can he frame to himself any reasonable picture of civilised society, or of the origin and development of human faculty and human organisation?

Somewhat the same, though of course in a highly mitigated degree, are the disadvantages under which the pure temperate education labours, when compared with the education unconsciously drunk in at every pore by an intelligent mind in tropical climates. And fully to understand this pregnant educational importance of the Tropics we must consider with ourselves how large a part tropical conditions have borne in the development of life in general, and of human life and society in particular.

The Tropics, we must carefully remember, are the norma of nature: the way things mostly are and always have been. They represent to us the common condition of the whole world during by far the greater part of its entire existence. Not only are they still in the strictest sense the biological head-quarters: they are also the standard or central type by which we must explain all the rest of nature, both in man and beast, in plant and animal.

The temperate and arctic worlds, on the other hand, are a mere passing accident in the history of our planet: a hole-and-corner development; a special result of the great Glacial epoch, and of that vast slow secular cooling which preceded and led up to it, from the beginning of the Miocene or Mid-Tertiary

period. Our European ideas, poor, harsh, and narrow, are mainly formed among a chilled and stunted fauna and flora, under inclement skies, and in gloomy days, all of which can give us but a very cramped and faint conception of the joyous exuberance, the teeming vitality, the fierce hand-to-hand conflict, and the victorious exultation of tropical life in its full free development.

All through the Primary and Secondary epochs of geology, it is now pretty certain, hothouse conditions practically prevailed almost without a break over the whole world from pole to pole. It may be true, indeed, as Dr. Croli believes (and his reasoning on the point I confess is fairly convincing), that from time to time glacial periods in one or other hemisphere broke in for a while upon the genial warmth that characterised the greater part of those vast and immeasurable primæval æons. But even if that were so—if at long intervals the world for some hours in its cosmical year was chilled and frozen in an insignificant cap at either extremity—these casual episodes in a long story do not interfere with the general truth of the principle that life as a whole during the greater portion of its antique existence has been carried on under essentially tropical conditions. No matter what geological formation we examine, we find everywhere the same tale unfolded in plain inscriptions before our eyes. Take, for example, the giant club-mosses and luxuriant tree-ferns nature-printed on shales of the coal age in Britain: and we see in the wild undergrowth of those palæozoic forests ample evidence of a warm and almost West Indian climate among the low basking

islets of our northern carboniferous seas. Or take once more the oolitic epoch in England, lithographed on its own mud, with its puzzle-monkeys and its sago-palms, its crocodiles and its deinosaurs, its winged pterodactyls and its whale-like lizards. All these huge creatures and these broad-leaved trees plainly indicate the existence of a temperature over the whole of Northern Europe almost as warm as that of the Malay Archipelago in our own day. The weather report for all the earlier ages stands almost uninterruptedly at Set Fair.

Roughly speaking, indeed, one may say that through the long series of Primary and Secondary formations hardly a trace can be found of ice or snow, autumn or winter, leafless boughs or pinched and starved deciduous vegetation. Everything is powerful, luxuriant, vivid. Life, as Comus feared, was strangled with its waste fertility. Once, indeed, in the Permian Age, all over the temperate regions, north and south, we get passing indications of what seems very like a glacial epoch, partially comparable to that great glaciation on whose last fringe we still abide to-day. But the Ice Age of the Permian, if such there were, passed away entirely, leaving the world once more warm and fruitful up to the very poles under conditions which we would now describe as essentially tropical.

It was with the Tertiary period—perhaps, indeed, only with the middle subdivision of that period—that the gradual cooling of the polar and intermediate regions began. We know from the deposits of the chalk epoch in Greenland that late in

Secondary times ferns, magnolias, myrtles, and sago-palms—an Indian or Mexican flora—flourished exceedingly in what is now the dreariest and most ice-clad region of the northern hemisphere. Later still, in the Eocene days, though the plants of Greenland had grown slightly more temperate in type, we still find among the fossils, not only oaks, planes, vines, and walnuts, but also wellingtonias like the big trees of California, Spanish chestnuts, quaint southern salisburias, broad-leaved liquidambars, and American sassafras. Nay, even in glacier-clad Spitzbergen itself, where the character of the flora already begins to show signs of incipient chilling, we nevertheless see among the Eocene types such plants as the swamp-cyprus of the Carolinas and the wellingtonias of the Far West, together with a rich forest vegetation of poplars, birches, oaks, planes, hazels, walnuts, water-lilies, and irises. As a whole, this vegetation still bespeaks a climate considerably more genial, mild, and equable than that of modern England.

It was in this basking world of the chalk and the Eocene that the great mammalian fauna first took its rise; it was in this easy world of fruits and sunshine that the primitive ancestors of man first began to work upwards toward the distinctively human level of the palæolithic period.

But then, in the mid-career of that third day of the geological drama, came a frost—a nipping-frost; and slowly but surely the whole arctic and antarctic worlds were chilled and cramped, degree after degree, by the gradual on-coming of the Great Ice

Age. I am not going to deal here with either the causes or the extent of that colossal cataclysm; I shall take all those for granted at present: what we are concerned with now are the results it left behind—the changes which it wrought on fauna and flora and on human society. Especially is it of importance in this connection to point out that the Glacial epoch is not yet entirely finished—if, indeed, it is ever destined to be finished. We are living still on the fringe of the Ice Age, in a cold and cheerless era, the legacy of the accumulated glaciers of the northern and southern snow-fields.

If once that ice were melted off—ah, well, there is much virtue in an *if*. Still, Mr. Alfred Russel Wallace seems to suggest somewhere that the sun is gradually making inroads even now on those great glacier-sheets of the northern cap, just as we know he is doing on the smaller glacier-sheets of Switzerland (most of which are receding), and that in time perhaps (say in a hundred thousand years or so) warm ocean currents may once more penetrate to the very poles themselves. That, however, is neither here nor there. The fact remains that we of Northern Europe live to-day in a cramped, chilled, contracted world; a world from which all the larger, fiercer, and grander types have either been killed off or driven south; a world which stands to the full and vigorous world of the Eocene and Miocene periods in somewhat the same relation as Lapland stands to-day to Italy or the Riviera.

This being so, it naturally results that if we want really to

understand the history of life, its origin and its episodes, we must turn nowadays to that part of our planet which still most nearly preserves the original conditions—that is to say, the Tropics. And it has always seemed to me, both *à priori* and *à posteriori*, that the Tropics on this account do really possess for every one of us a vast and for the most part unrecognised educational importance.

I say 'for every one of us,' of deliberate design. I don't mean merely for the biologist, though to him, no doubt, their value in this respect is greatest of all. Indeed, I doubt whether the very ideas of the struggle for life, natural selection, the survival of the fittest, would ever have occurred at all to the stay-at-home naturalists of the Linnæan epoch. It was in the depths of Brazilian forests, or under the broad shade of East Indian palms, that those fertile conceptions first flashed independently upon two southern explorers. It is very noteworthy indeed that all the biologists who have done most to revolutionise the science of life in our own day—Darwin, Huxley, Wallace, Bates, Fritz Müller, and Belt—have without exception formed their notions of the plant and animal world during tropical travels in early life. No one can read the 'Voyage of the *Beagle*,' the 'Naturalist on the Amazons,' or the 'Malay Archipelago' without feeling at every page how profoundly the facts of tropical nature had penetrated and modified their authors' minds. On the other hand, it is well worth while to notice that the formal opposition to the new and more expansive evolutionary views came mainly from the museum and laboratory type of naturalists in London

and Paris, the official exponents of dry bones, who knew nature only through books and preserved specimens, or through her impoverished and far less plastic developments in northern lands. The battle of organic evolution has been waged by the Darwins, the Huxleys, and the Müllers on the one hand, against the Cuviers, the Owens, and the Virchows on the other.

Still, it is not only in biology, as I said just now, that a taste of the Tropics in early life exerts a marked widening and philosophic influence upon a man's whole mental horizon. In ten thousand ways, in that great tropical university, men feel themselves in closer touch than elsewhere with the ultimate facts and truths of nature. I don't know whether it is all fancy and preconceived opinion, but I often imagine when I talk with new-met men that I can detect a certain difference in tone and feeling at first sight between those who have and those who have not passed the Tropical Tripos. In the Tropics, in short, we seem to get down to the very roots of things. Thousands of questions, social, political, economical, ethical, present themselves at once in new and more engagingly simple aspects. Difficulties vanish, distinctions disappear, conventions fade, clothes are reduced to their least common measure, man stands forth in his native nakedness. Things that in the North we had come to regard as inevitable—garments, firing, income tax, morality—evaporate or simplify themselves with instructive ease and phantasmagoric readiness. Malthus and the food question assume fresh forms, as in dissolving views, before our very eyes. How are slums

conceivable or East Ends possible where every man can plant his own yam and cocoa-nut, and reap their fruit four-hundred-fold? How can Mrs. Grundy thrive where every woman may rear her own ten children on her ten-rood plot without aid or assistance from their indeterminate fathers? What need of carpentry where a few bamboos, cut down at random, can be fastened together with thongs into a comfortable chair? What use of pottery where calabashes hang on every tree, and cocoa-nuts, with the water fresh and pure within, supply at once the cup, and the filter, and the Apollinaris within?

Of course I don't mean to assert, either, that this tropical university will in itself suffice for all the needs of educated or rather of educable men. It must be taken, *bien entendu*, as a supplementary course to the Literæ Humaniores. There are things which can only be learnt in the crowded haunts and cities of men—in London, Paris, New York, Vienna. There are things which can only be learnt in the centres of culture or of artistic handicraft—in Oxford, Munich, Florence, Venice, Rome. There is only one Grand Canal and only one Pitti Palace. We must have Shakespeare, Homer, Catullus, Dante; we must have Phidias, Fra Angelico, Rafael, Mendelssohn; we must have Aristotle, Newton, Laplace, Spencer. But after all these, and before all these, there is something more left to learn. Having first read them, we must read ourselves out of them. We must forget all this formal modern life; we must break away from this cramped, cold, northern world; we must find ourselves face to face at last,

in Pacific isles or African forests, with the underlying truths of simple naked nature. For that, in its perfection, we must go to the Tropics; and there, we shall learn and unlearn much, coming back, no doubt, with shattered faiths and broken gods, and strangely disconcerted European prejudices, but looking out upon life with a new outlook, an outlook undimmed by ten thousand preconceptions which hem in the vision and obstruct the view of the mere temperately educated.

Nor is it only on the *élite* of the world that this tropical training has in its own way a widening influence. It is good, of course, for our Galtons to have seen South Africa; good for our Tylors to have studied Mexico; good for our Hookers to have numbered the rhododendrons and deodars of the Himalayas. I sometimes fancy, even, that in the works of our very greatest stay-at-home thinkers on anthropological or sociological subjects, I detect here and there a certain formalist and schematic note which betrays the want of first-hand acquaintance with the plastic and expansive nature of tropical society. The beliefs and relations of the actual savage have not quite that definiteness of form and expression which our University Professors would fain assign to them. But apart from the widening influence of the Tropics on these picked minds, there is a widening influence exerted insensibly on the very planters or merchants, the rank and file of European settlers, which can hardly fail to impress all those who have lived amongst them. The cramping effect of the winter cold and the artificial life is all removed. Men live in a freer,

wider, warmer air; their doors and windows stand open day and night; the scent of flowers and the hum of insects blow in upon them with every breeze; their brother man and sister woman are more patent in every action to their eyes; the world shows itself more frankly; it has fewer secrets, and readier sympathies. I don't mean to say the result is all gain. Far from it. There are evils inherent in tropical life which, as a noble lord remarks of nature generally, "no preacher can heal." But viewed as education, like Saint-Simon's thieving, it is all valuable. I should think most men who have once passed through a tropical experience would no more wish that full chapter blotted out of their lives than they would consent to lose their university culture, their Continental travel, or their literary, scientific, or artistic education.

And what are the elements of this tropical curriculum which give it such immense educational value? I think they are manifold. A few only may be selected as of typical importance.

In the first place, because first in order of realisation, there is its value as a mental *bouleversement*, a revolution in ideas, a sort of moral and intellectual cold shower-bath, a nervous shock to the system generally. The patient or pupil gets so thoroughly upset in all his preconceived ideas; he finds all round him a life so different from the life to which he has been accustomed in colder regions, that he wakes up suddenly, rubs his eyes hard, and begins to look about him for some general explanation of the world he lives in. It is good for the ordinary man to get thus unceremoniously upset. Take the average young intelligence of

the London streets, with its glib ideas already formed from supply and demand in a civilised country, where soil is appropriated, and classes distinct, and commodities drop as it were from the clouds upon the middle-class breakfast-table—take such an intelligence, self-satisfied and empty, and place its possessor all at once in a new environment, where everything material, mental, and moral seems topsy-turvy, where life is real and morals are rudimentary—and unless he is a very particular fool indeed, what a lot you must really give that blithe new-comer to turn over and think about! The sun that shifts now north, now south of him; the seasons that go by fours instead of twos; the trees that blossom and bear fruit from January to December, with no apparent regard for the calendar months as by law established; the black, brown, or yellow people, who know not his creed or his social code; the castes and cross-divisions that puzzle and surprise him; the pride and the scruples, deeper than those of civilised life, but that nevertheless run counter to his own; the economic conditions that defy his preconceptions; the virtues and the vices that equally rub him up the wrong way—all these things are highly conducive to the production of that first substratum of philosophic thinking, a Socratic attitude of supreme ignorance, a pure Cartesian frame of universal doubt.

Then again there is the marvellous exuberance and novelty of the fauna and flora. And this once more has something better for us all than mere specialist interest. Sugar and ginger grow for all alike. For we must remember that not only do the Tropics

represent the vastly greater portion of the world's past: they also represent the vastly greater portion of the world's present. By far the larger part of the land surface of the earth is tropical or subtropical; the temperate and arctic regions make up but a minor and unimportant fraction of the soil of our planet. And if we include the sea as well, this truth becomes even more strikingly evident: the Tropics are even now the rule of life; the colder regions are but an abnormal and outlying eccentricity of nature. Yet it is from this starved and dwarfed and impoverished northern area that most of us have formed our views of life, to the total exclusion of the wider, richer, more varied world that calls for our admiration in tropical latitudes.

Insensibly this richness and vividness of nature all around one, on a first visit to the Tropics, sinks into one's mind, and produces profound, though at first unconscious, modifications in one's whole mode of regarding man and his universe. Especially is this the case in early life, when the character is still plastic and the eye still keen: pictures are formed in that brilliant sunshine and under those dim arches of hot grey sky that photograph themselves for ever on the lasting tablets of the human memory. John Stuart Mill in his Autobiography dwells lovingly, I remember, on the profound effect produced on himself by his childish visits to Jeremy Bentham at Ford Abbey in Dorsetshire, on the delightful sense of space and freedom and generous expansion given to his mind by the mere act of living and moving in those stately halls and wide airy gardens. Every university man must look back with

pleasure of somewhat the same sort to the free breezy memories of the quadrangles and common rooms of Christ Church or of Trinity. But in the tropical university everybody passes his time in arcades of Greek or Pompeian airiness: the palm-trees wave and whisper around his head as he sits for coolness on his wide verandah; the humming-birds dart from flower to flower on the delicate bouquets that crowd his drawing-room. I knew a lady who made a capital collection of butterflies and moths at her own dinner-table by simply impounding in paper boxes the insects that flitted about the lamp at dessert. Why, if it comes to that, the very bread itself comprises generally a whole entomological cabinet, and contains in fragments the *disjecta membra* of specimens enough to stock entire glass cases at severe South Kensington. How's that for an inducement to study life where it is richest and most abundant in its native starting-place?

But above all in educational importance I rank the advantage of seeing human nature in its primitive surroundings, far from the squalid and chilly influences of the tail-end of the Glacial epoch. I admit at once that cold has done much, exceeding much, for human development—has been the mother of civilisation in somewhat the same sense that necessity has been the mother of invention. To it, no doubt, we owe to a great extent, in varying stages, clothing, the house, fire, the steam-engine. Yet none the less is it true that the first levels of society must needs have been passed under essentially tropical conditions, and that nascent civilisation spread but slowly northward, from Egypt and Asia,

through Greece and Italy, to the cloudy regions where its chief centres are at present domiciled under canopies of coal smoke. And even to-day the sight of the tropics, green and luxuriant, brings us into touch at once with earlier ideas and habits of the race—makes us more able not only to understand, but also to sympathise with, our ancient ancestors of the naked-and-not-ashamed era of culture. Views formed exclusively in the North tend too much to imitate the reduced gentlewoman's outlook upon life; views formed in the Tropics correct this refractive influence by a certain genial and tolerant virile expansion, not to be learned at the Common, Clapham.

To one whose economic pendulum has hitherto oscillated between selfish luxury in Mayfair and squalid poverty in Seven Dials, there is indeed a world of novelty in the first view of the tropical poverty that is not squalid but contentedly luxurious—of the dusky father with his wife or wives (the mere number is a detail) sprawling at full length, half clad, in the eye of the sun, before the palm-thatched hut, while the fat black babies and the fat black little pigs wallow together almost indistinguishably in the dust at his side, just out of reach of the muscular foot that might otherwise of pure wantonness molest them. What a flood of light it all casts upon the future possibilities of society, that leisured, cultureless household, on whose garden-plot yam or bread-fruit or bananas or sweet potatoes can be grown in sufficient quantity to support the family without more labour than in England would pay for its kitchen coals; where the hut

is but a shelter from rain, or a bed-curtain for night, and where the untaxed sun supplies the place of a drawing-room fire all the year round, and warms the water for the baby's bath at nothing the gallon! If there is any man who doesn't sympathise with his dusky brother when he sees him thus at home in his airy palace—any man who doesn't fraternise closely with his kind when thus brought face to face with our primitive existence, I don't envy him his stern and wild Caledonian ethics. The beach-comber instinct should be strong in all sane minds. Or if that blunt way of putting it perchance offend the weaker brethren, let us say rather, the spirit of the Lotus-eaters. For the man who doesn't want to eat of the Lotus just once in his life has become too civilised: the iron of the Gradgrind era of universal competition and payment by results has entered to deeply into his sordid soul. He wants a course of Egypt and Tahiti.

Oh, yes; I know what you are going to object, and I grant it at once: the influence of the Tropics is by no means an ascetic one. They, tend rather to encourage a certain genial and friendly tolerance of all possible human forms of society—even the lowest. They are essentially democratic, not to say socialistic and revolutionary in tone. By bringing us all down to the underlying verities of life, apart from its conventions, they beget perhaps a somewhat hasty impatience of Court dress and the Lord Chamberlain's regulations. But, *per contra*, they teach us to feel that every man, whether black, brown, or white, is very human, and every woman and child, if possible, even a trifle

more so. Wicked as it all is, there is yet in tropical political economy more of the Gospel according to St. John, and less of Adam Smith, Ricardo, and Malthus, than in any orthodox political economy prescribed by examiners for the University of London. It is something to see a world where ceaseless toil is not the necessary and inevitable lot of all who don't pay income tax on a thousand a year, even if Board schools are unknown and quadratic equations a vanishing quantity. It is something to see a stick of sugar-cane protruding from the mouth of every child, and oranges retailed at twelve for a ha'penny. It is something to know how the vast majority of the human race still live and move and have their being, and to feel that after all their mode of life, though lacking in Greek iambics, wallpapers, and the *Saturday Review*, yet appeals in its own beach-comberish way to some of one's inmost and deepest yearnings. The hibiscus that flames before the wattled hut, the parrot that chatters from the green and golden mango-tree, the lithe, healthy figures of the children in the stream, are some compensation for the lack of London mud, London fog, and London illustrations of practical Christianity in the Isle of Dogs and the Bermondsey purlieus. I don't know whether I am knocking the last nail into the completed coffin of my own contention, but I believe every right-minded man returns from the Tropics a good deal more of a Communist than when he went there.

One word of explanation to prevent mistake. I am not myself, like Kingsley or Wallace, an enthusiastic tropicist. On the

contrary, viewed as a place of permanent residence, I don't at all like the Tropics to live in. I am pleading here only for their educational value, in small doses. Spending two or three years there in the heyday of life is very much like reading Herodotus —a thing one is glad one had once to do, but one would never willingly do again for any money. We northern creatures are remote products of the Great Ice Age, and by this time, like Polar bears, we have grown adapted to our glacial environment. All the more, therefore, is it a useful shaking-up for us to get transported bodily from our cramped and poverty-stricken northern slums, just once in our life, to the palms and temples of the South, the lands where the human body is a hardy plant, not a frail exotic. We come back to our chilly home among the fogs and bogs with wider projects for the thawing down of the social ice-heap, and the introduction of the bread-fruit-tree and the currant-bun-bush into the remotest wilds of the borough of Hackney. I am not even quite sure that tropical experience doesn't predispose us somewhat in favour of planting the sweet potato instead of grazing battering-rams in the uplands of Connemara. But hush; I hear an editorial frown. No more of this heresy.

ON THE WINGS OF THE WIND

Of course, you know my friend the squirting cucumber. If you don't, that can be only because you've never looked in the right place to find him. On all waste ground outside most southern cities—Nice, Cannes, Florence: Rome, Algiers, Granada: Athens, Palermo, Tunis, where you will—the soil is thickly covered by dark trailing vines which bear on their branches a queer hairy green fruit, much like a common cucumber at that early stage of its existence when we know it best in the commercial form of pickled gherkins. As long as you don't interfere with them, these hairy green fruits do nothing out of the common in the way of personal aggressiveness. Like the model young lady of the books on etiquette, they don't speak unless they're spoken to. But if peradventure you chance to brush up against the plant accidentally, or you irritate it of set purpose with your foot or your cane, then, as Mr. Rider Haggard would say, 'a strange thing happens': off jumps the little green fruit with a startling bounce, and scatters its juice and pulp and seeds explosively through a hole in the end where the stem joined on to it. The entire central part of the cucumber, in short (answering to the seeds and pulp of a ripe melon), squirts out elastically through the breach in the outer wall, leaving the hollow shell behind as a mere empty windbag.

Naturally, the squirting cucumber knows its own business

best, and is not without sufficient reasons of its own for this strange and, to some extent, unmannerly behaviour. By its queer trick of squirting, it manages to kill at least two birds with one stone. For, in the first place, the sudden elastic jump of the fruit frightens away browsing animals, such as goats and cattle. Those meditative ruminants are little accustomed to finding shrubs or plants take the aggressive against them; and when they see a fruit that quite literally flies in their faces of its own accord, they hesitate to attack the uncanny vine which bristles with such magical and almost miraculous defences. Moreover, the juice of the squirting cucumber is bitter and nauseous, and if it gets into the eyes or nostrils of man or beast, it impresses itself on the memory by stinging like red pepper. So the trick of squirting serves in a double way as a protection to the plant against the attacks of herbivorous animals and other enemies.

But that's not all. Even when no enemy is near, the ripe fruits at last drop off of themselves, and scatter their seeds elastically in every direction. This they do simply in order to disseminate their kind in new and unoccupied spots, where the seedlings will root and find an opening in life for themselves. Observe, indeed, that the very word 'disseminate' implies a general vague recognition of this principle of plant-life on the part of humanity. It means, etymologically, to scatter seed; and it points to the fact that everywhere in nature seeds are scattered broadcast, infinite pains being taken by the mother-plant for their general diffusion over wide areas of woodland, plain, or prairie.

Let us take as examples a single little set of instances, familiar to everybody, but far commoner in the world at large than the inhabitants of towns are at all aware of: I mean, the winged seeds, that fly about freely in the air by means of feathery hairs or gossamer, like thistle-down and dandelion. Of these winged types we have many hundred varieties in England alone. All the willow-herbs, for example, have such feathery seeds (or rather fruits) to help them on their way through life; and one kind, the beautiful pink rose-bay, flies about so readily, and over such wide spaces of open country, that the plant is known to farmers in America as fireweed, because it always springs up at once over whole square miles of charred and smoking soil after every devastating forest fire. It travels fast, for it travels like Ariel. In much the same way, the coltsfoot grows on all new English railway banks, because its winged seeds are wafted everywhere in myriads on the winds of March. All the willows and poplars have also winged seeds: so have the whole vast tribe of hawkweeds, groundsels, ragworts, thistles, fleabanes, cat's-ears, dandelions, and lettuces. Indeed, one may say roughly, there are very few plants of any size or importance in the economy of nature which don't deliberately provide, in one way or another, for the dispersal and dissemination of their fruits or seedlings.

Why is this? Why isn't the plant content just to let its grains or berries drop quietly on to the soil beneath, and there shift for themselves as best they may on their own resources?

The answer is a more profound one than you would at first

imagine. Plants discovered the grand principle of the rotation of crops long before man did. The farmer now knows that if he sows wheat or turnips too many years running on the same plot, he 'exhausts the soil,' as we say—deprives it of certain special mineral or animal constituents needful for that particular crop, and makes the growth of the plant, therefore, feeble or even impossible. To avoid this misfortune, he lets the land lie fallow, or varies his crops from year to year according to a regular and deliberate cycle. Well, natural selection forced the same discovery upon the plants themselves long before the farmer had dreamed of its existence. For plants, being, in the strictest sense, 'rooted to the spot,' absolutely require that all their needs should be supplied quite locally. Hence, from the very beginning, those plants which scattered their seeds widest throve the best; while those which merely dropped them on the ground under their own shadow, and on soil exhausted by their own previous demands upon it, fared ill in the struggle for life against their more discursive competitors. The result has been that in the long run few species have survived, except those which in one way or another arranged beforehand for the dispersal of their seeds and fruits over fresh and unoccupied areas of plain or hillside.

I don't, of course, by any means intend to assert that seeds always do it by the simple device of wings or feathery projections. Every variety of plan or dodge or expedient has been adopted in turn to secure the self-same end; and provided only it succeeds in securing it, any variety of them all is equally satisfactory.

One might parallel it with the case of hatching birds' eggs. Most birds sit upon their eggs themselves, and supply the necessary warmth from their own bodies. But any alternative plan that attains the same end does just as well. The felonious cuckoo drops her foundlings unawares in another bird's nest: the ostrich trusts her unhatched offspring to the heat of the burning desert sand: and the Australian brush-turkeys, with vicarious maternal instinct, collect great mounds of decaying and fermenting leaves and rubbish, in which they deposit their eggs to be artificially incubated, as it were, by the slow heat generated in the process of putrefaction. Just in the same way, we shall see in the case of seeds that any method of dispersion will serve the plant's purpose equally well, provided only it succeeds in carrying a few of the young seedlings to a proper place in which they may start fair at last in the struggle for existence.

As in the case of the fertilization of flowers, so in that of the dispersal of seeds, there are two main ways in which the work is effected—by animals and by wind-power. I will not insult the intelligence of the reader at the present time of day by telling him that pollen is usually transferred from blossom to blossom in one or other of these two chief ways—it is carried on the heads or bodies of bees and other honey-seeking insects, or else it is wafted on the wings of the wind to the sensitive surface of a sister-flower. So, too, seeds are for the most part either dispersed by animals or blown about by the breezes of heaven to new situations. These are the two most obvious means of locomotion

provided by nature; and it is curious to see that they have both been utilized almost equally by plants, alike for their pollen and their seeds, just as they have been utilized by man for his own purposes on sea or land, in ship, or windmill, or pack-horse, or carriage.

There are two ways in which animals may be employed to disperse seeds—voluntarily and involuntarily. They may be compelled to carry them against their wills: or they may be bribed and cajoled and flattered into doing the plant's work for it in return for some substantial advantage or benefit the plant confers upon them. The first plan is the one adopted by burrs and cleavers. These adhesive fruits are like the man who buttonholes you and won't be shaken off: they are provided with little curved hooks or bent and barbed hairs which catch upon the wool of sheep, the coat of cattle, or the nether integuments of wayfaring humanity, and can't be got rid of without some little difficulty. Most of them, you will find on examination, belonged to confirmed hedgerow or woodside plants: they grow among bushes or low scrub, and thickets of gorse or bramble. Now, to such plants as these, it is obviously useful to have adhesive fruits and seeds: for when sheep or other animals get them caught in their coats, they carry them away to other bushy spots, and there, to get rid of the annoyance caused by the foreign body, scratch them off at once against some holly-bush or blackthorn. You may often find seeds of this type sticking on thorns as the nucleus of a little matted mass of wool, so left by the sheep in the very spots

best adapted for the free growth of their vigorous seedlings.

Even among plants which trust to the involuntary services of animals in dispersing their seeds, a great many varieties of detail may be observed on close inspection. For example, in hound's-tongue and goose-grass, two of the best-known instances among our common English weeds, each little nut is covered with many small hooks, which make it catch on firmly by several points of attachment to passing animals. These are the kinds we human beings of either sex oftenest find clinging to our skirts or trousers after a walk in a rabbit-warren. But in herb-bennet and avens each nut has a single long awn, crooked near the middle with a very peculiar S-shaped joint, which effectually catches on to the wool or hair, but drops at the elbow after a short period of withering. Sometimes, too, the whole fruit is provided with prehensile hooks, while sometimes it is rather the individual seeds themselves that are so accommodated. Oddest of all is the plan followed by the common burdock. Here, an involucre or common cup-shaped receptacle of hooked bracts surrounds an entire head of purple tubular flowers, and each of these flowers produces in time a distinct fruit; but the hooked involucre contains the whole compound mass, and, being pulled off bodily by a stray sheep or dog, effects the transference of the composite lot at once to some fitting place for their germination.

Those plants, on the other hand, which depend rather, like London hospitals, upon the voluntary system, produce that very familiar form of edible capsule which we commonly call in the

restricted sense a fruit or berry. In such cases, the seed-vessel is usually swollen and pulpy: it is stored with sweet juices to attract the birds or other animal allies, and it is brightly coloured so as to advertise to their eyes the presence of the alluring sugary foodstuff. These instances, however, are now so familiar to everybody that I won't dwell upon them at any length. Even the degenerate schoolboy of the present day, much as he has declined from the high standard set forth by Macaulay, knows all about the way the actual seed itself is covered (as in the plum or the cherry) by a hard stony coat which 'resists the action of the gastric juice' (so physiologists put it, with their usual frankness), and thus passes undigested through the body of its swallower. All I will do here, therefore, is to note very briefly that some edible fruits, like the two just mentioned, as well as the apricot, the peach, the nectarine, and the mango, consist of a single seed with its outer covering; in others, as in the raspberry, the blackberry, the cloudberry, and the dew-berry, many seeds are massed together, each with a separate edible pulp; in yet others, as in the gooseberry, the currant, the grape, and the whortleberry, several seeds are embedded within the fruit in a common pulpy mass; and in others again, as in the apple, pear, quince, and medlar, they are surrounded by a quantity of spongy edible flesh. Indeed, the variety that prevails among fruits in this respect almost defies classification: for sometimes, as in the mulberry, the separate little fruits of several distinct flowers grow together at last into a common berry: sometimes, as in a fig, the

general flower-stalk of several tiny one-seeded blossoms forms the edible part: and sometimes, as in the strawberry, the true little nuts or fruits appear as mere specks or dots on the bloated surface of the swollen and overgrown stem, which forms the luscious morsel dear to the human palate.

Yet in every case it is interesting to observe that, while the seeds which depend for dispersion upon the breeze are easily detached from the parent plant and blown about by every wind of doctrine, the seeds or fruits which depend for their dispersion upon birds or animals always, on the contrary, hang on to their native boughs to the very last, till some unconscious friend pecks them off and devours them. Haws, rose-hips, and holly-berries will wither and wilt on the tree in mild winters, because they can't drop off of themselves without the aid of birds, while the birds are too well supplied with other food to care for them. One of the strangest cases of all, however, is that of the mistletoe, which, living parasitically upon the forest-boughs and apple-trees, would of course be utterly lost if its berries dropped their seeds on to the ground beneath it. To avoid such a misfortune, the mistletoe berries are filled with an exceedingly viscid and sticky pulp, surrounding the hard little nut-like seeds: and this pulp makes the seeds cling to the bills and feet of various birds which feed upon the fruit, but most particularly of the missel thrush, who derives his common English name from his devotion to the mistletoe. The birds then carry them away unwittingly to some neighbouring tree, and rub them off, when they get

uncomfortable, against a forked branch—the exact spots that best suits the young mistletoe for sprouting in. Man, in turn, makes use of the sticky pulp for the manufacture of bird-lime, and so employs against the birds the very qualities which the plant intended as a bribe for their kindly services.

Among seeds that trust for their disposal to the wind, the commonest, simplest, and least evolved type is that of the ordinary capsule, as in the poppies and campions. At first sight, to be sure, a casual observer might suppose there existed in these cases no recognisable device at all for the dissemination of the seedlings. But you and I, most excellent and discreet reader, are emphatically *not*, of course, mere casual observers. *We* look close, and go to the very root of things. And when we do so, we see for ourselves at once that almost all capsules open—where? why, at the top, so that the seeds can only be shaken out when there is a high enough wind blowing to sway the stems to and fro with some violence, and scatter the small black grains inside to a considerable distance. Furthermore, in many instances, of which the common poppy-head is an excellent example, the capsule opens by lateral pores at the top of a flat head—a further precaution which allows the seeds to get out only by a few at a time, after a distinct jerk, and so scatters them pretty evenly, with different winds, over a wide circular space around the mother plant. Experiment will show how this simple dodge works. Try to shake out the poppy-seed from a ripe poppy-head on the plant as it grows, without breaking the stem or bending it unnaturally,

and you will easily see how much force of wind is required in order to put this unobtrusive but very effective mechanism into working order.

The devices of this character employed by various plants for the dispersal of seeds even in ordinary dry capsules are far too numerous for me to describe in full detail, though they form a delightful subject for individual study in any small suburban garden. I will only give one more illustrative case, just to show the sort of point an amateur should always be on the look-out for. There is an extremely common, though inconspicuous, English weed, the mouse-ear chickweed, found everywhere in flower-beds or grass-plots, however small, and noticeable for its quaint little horn-shaped capsules. These have a very odd sort of twist or cock-up in the middle, just above the part where the seeds lie; and they open at the top by ten small teeth, pointed obliquely outward for no apparent reason. Yet every point has a meaning of its own for all that. The plant is one that lies rather close upon the ground; and the effect of this twist in the capsule is that the seeds, which are relatively heavy, and well stored with nutriment, can never get out at all, unless a very strong wind is blowing, which sweeps over the herbage in long quick waves, and carries everything it shakes out for great distances before it. So much design have even the smallest weeds put into the mechanism for the dispersion of their precious seeds, the hope of their race and the earnest of their future!

Artillery marks a higher stage than the sling and the stone.

Just so, in many plants, a step higher in the evolutionary scale as regards the method of dispersion, the capsule itself bursts open explosively, and scatters its contents to the four winds of heaven. Such plants may be said to discharge their grains on the principle of the bow and arrow. The balsam is a familiar example of this startling mode of moving to fresh fields and pastures new: its capsule consists of five long straight valves, which break asunder elastically the moment they are touched, when fully ripe, and shed their seeds on all sides, like so many small bombshells. Our friend the squirting cucumber, which served as the prime text for this present discourse, falls into somewhat the same category, though in other ways it rather resembles the true succulent fruits, and belongs, indeed, to the same family as the melon, the gourd, the pumpkin, and the vegetable-marrow, almost all of which are edible and in every way fruit-like. Among English weeds, the little bittercress that grows on dry walls and hedge-banks forms an excellent example of the same device. Village children love to touch the long, ripe, brown capsules on the top with one timid finger, and then jump away, half laughing, half terrified, when the mild-looking little plant goes off suddenly with a small bang and shoots its grains like a catapult point-blank in their faces.

It is in the tropics, however, that these elastic fruits reach their highest development. There they have to fight, not merely against such small fry as robins, squirrels, and harvest-mice, but against the aggressive parrot, the hard-billed toucan, the persistent lemur, and the inquisitive monkey. Moreover, the

elastic fruits of the tropics grow often on spreading forest trees, and must therefore shed their seeds to immense distances if they are to reach comparatively virgin soil, unexhausted by the deep-set roots of the mother trunk. Under such exceptional circumstances, the tropical examples of these elastic capsules are by no means mere toys to be lightly played with by babes and sucklings. The sand-box tree of the West Indies has large round fruits, containing seeds about as big as an English horsebean; and the capsule explodes, when ripe, with a detonation like a pistol, scattering its contents with as much violence as a shot from an air-gun. It is dangerous to go too near these natural batteries during the shooting season. A blow in the eye from one would blind a man instantly. I well remember the very first night I spent in my own house in Jamaica, where I went to live shortly after the repression of 'Governor Eyre's rebellion,' as everybody calls it locally. All night long I heard somebody, as I thought, practising with a revolver in my own back garden: a sound which somewhat alarmed me under those very unstable social conditions. An earthquake about midnight, it is true, diverted my attention temporarily from the recurring shots, but didn't produce the slightest effect upon the supposed rebel's devotion to the improvement of his marksmanship. When morning dawned, however, I found it was only a sand-box tree, and that the shots were nothing more than the explosions of the capsules. As to the wonderful tales told about the Brazilian cannon-ball tree, I cannot personally endorse them from original

observation, and will not stain this veracious page with any second-hand quotations from the strange stories of modern scientific Munchausens.

Still higher in the evolutionary scale than the elastic fruits are those airy species which have taken to themselves wings like the eagle, and soar forth upon the free breeze in search of what the Americans describe as 'fresh locations.' Of this class the simplest type may be seen in those forest-trees, like the maple and the sycamore, whose fruits are flattened out into long expansions or parachutes, technically known as 'keys,' by whose aid they flutter down obliquely to the ground at a considerable distance. The keys of the sycamore, to take a single instance, when detached from the tree in autumn, fall spirally through the air owing to the twist of the winged arm, and are carried so far that, as every gardener knows, young sycamore trees rank among the commonest weeds among our plots and flower-beds. A curious variant upon this type is presented by the lime, or linden, whose fruits are in themselves small wingless nuts; but they are born in clusters upon a common stalk, which is winged on either side by a large membranous bract. When the nuts are ripe, the whole cluster detaches itself in a body from the branch, and flutters away before the breeze by means of the common parachute, to some spot a hundred yards or more, where the wind chances to land it.

The topmost place of all in the hierarchy of seed life, it seems to me, is taken by the feathery fruits and seeds which

float freely hither and thither wherever the wind may bear them. An immense number of the very highest plants—the aristocrats of the vegetable kingdom, such as the lordly composites, those ultimate products of plant evolution—possess such floating feathery seeds; though here, again, the varieties of detail are too infinite for rapid or popular classification. Indeed, among the composites alone—the thistle and dandelion tribe with downy fruits—I can reckon up more than a hundred and fifty distinct variations of plan among the winged seeds known to me in various parts of Europe. But if I am strong, I am merciful: I will let the public off with a hundred and forty-eight of them. My two exceptions shall be John-go-to-bed-at-noon and the hairy hawkweed, both of them common English meadow-plants. The first, and more quaintly named, of the two has little ribbed fruits that end in a long and narrow beak, supporting a radial rib-work of spokes like the frame of an umbrella; and from rib to rib of this framework stretch feathery cross-pieces, continuous all round, so as to make of the whole mechanism a perfect circular parachute, resembling somewhat the web of a geometrical spider. But the hairy hawkweed is still more cunning in its generation; for that clever and cautious weed produces its seeds or fruits in clustered heads, of which the central ones are winged, while the outer are heavy, squat, and wingless. Thus does the plant make the best of all chances that may happen to open before it: if one lot goes far and fares but ill, the other is pretty sure to score a bull's-eye.

These are only a few selected examples of the infinite dodges

employed by enlightened herbs and shrubs to propagate their scions in foreign parts. Many more, equally interesting, must be left undescribed. Only for a single case more can I still find room —that of the subterranean clover, which has been driven by its numerous enemies to take refuge at last in a very remarkable and almost unique mode, of protecting its offspring. This particular kind of clover affects smooth and close-cropped hillsides, where the sheep nibble down the grass and other herbage almost as fast as it springs up again. Now, clover seeds resemble their allies of the pea and bean tribe in being exceedingly rich in starch and other valuable foodstuffs. Hence, they are much sought after by the inquiring sheep, which eat them off wherever found, as exceptionally nutritious and dainty morsels. Under these circumstances, the subterranean clover has learnt to produce small heads of bloom, pressed close to the ground, in which only the outer flowers are perfect and fertile, while the inner ones are transformed into tiny wriggling corkscrews. As soon as the fertile flowers have begun to set their seed, by the kind aid of the bees, the whole stem bends downward, automatically, of its own accord; the little corkscrews then worm their way into the turf beneath; and the pods ripen and mature in the actual soil itself, where no prying ewe can poke an inquisitive nose to grub them up and devour them. Cases like this point in certain ways to the absolute high-water-mark of vegetable ingenuity: they go nearest of all in the plant-world to the similitude of conscious animal intelligence.

A DESERT FRUIT

Who knows the Mediterranean, knows the prickly pear. Not that that quaint and uncanny-looking cactus, with its yellow blossoms and bristling fruits that seem to grow paradoxically out of the edge of thick fleshy leaves, is really a native of Italy, Spain, and North Africa, where it now abounds on every sun-smitten hillside. Like Mr. Henry James and Mr. Marion Crawford, the Barbary fig, as the French call it, is, in point of fact, an American citizen, domiciled and half naturalised on this side of the Atlantic, but redolent still at heart of its Columbian origin. Nothing is more common, indeed, than to see classical pictures of the Alma-Tadema school—not, of course, from the brush of the master himself, who is impeccable in such details, but fair works of decent imitators—in which Caia or Marcia leans gracefully in her white stole on one pensive elbow against a marble lintel, beside a courtyard decorated with a Pompeian basin, and overgrown with prickly pear or "American aloes." I need hardly say that, as a matter of plain historical fact, neither cactuses nor agaves were known in Europe till long after Christopher Columbus had steered his wandering bark to the sandy shores of Cat's Island in the Bahamas. (I have seen Cat's Island with these very eyes, and can honestly assure you that its shores *are* sandy.) But this is only one among the many pardonable little inaccuracies of painters, who thrust scarlet

geraniums from the Cape of Good Hope into the fingers of Aspasia, or supply King Solomon in all his glory with Japanese lilies of the most recent introduction.

At the present day, it is true, both the prickly-pear cactus and the American agave (which the world at large insists upon confounding with the aloe, a member of a totally distinct family) have spread themselves in an apparently wild condition over all the rocky coasts both of Southern Europe and of Northern Africa. The alien desert weeds have fixed their roots firmly in the sunbaked clefts of Ligurian Apennines; the tall candelabrum of the western agave has reared its great spike of branching blossoms (which flower, not once in a century, as legend avers, but once in some fifteen years or so) on all the basking hillsides of the Mauritanian Atlas. But for the origin, and therefore for the evolutionary history, of either plant, we must look away from the shore of the inland sea to the arid expanse of the Mexican desert. It was there, among the sweltering rocks of the Tierras Calientes, that these ungainly cactuses first learned to clothe themselves in prickly mail, to store in their loose tissues an abundant supply of sticky moisture, and to set at defiance the persistent attacks of all external enemies. The prickly pear, in fact, is a typical instance of a desert plant, as the camel is a typical instance of a desert animal. Each lays itself out to endure the long droughts of its almost rainless habitat by drinking as much as it can when opportunity offers, hoarding up the superfluous water for future use, and economising evaporation by every means in its power.

If you ask that convenient fiction, the Man in the Street, what sort of plant a cactus is, he will probably tell you it is all leaf and no stem, and each of the leaves grows out of the last one. Whenever we set up the Man in the Street, however, you must have noticed we do it in order to knock him down again like a nine-pin next moment: and this particular instance is no exception to the rule; for the truth is that a cactus is practically all stem and no leaves, what looks like a leaf being really a branch sticking out at an angle. The true leaves, if there are any, are reduced to mere spines or prickles on the surface, while the branches, in the prickly-pear and many of the ornamental hot-house cactuses, are flattened out like a leaf to perform foliar functions. In most plants, to put it simply, the leaves are the mouths and stomachs of the organism; their thin and flattened blades are spread out horizontally in a wide expanse, covered with tiny throats and lips which suck in carbonic acid from the surrounding air, and disintegrate it in their own cells under the influence of sunlight. In the prickly pears, on the contrary, it is the flattened stem and branches which undertake this essential operation in the life of the plant—the sucking-in of carbon and giving-out of oxygen, which is to the vegetable exactly what the eating and digesting of food is to the animal organism. In their old age, however, the stems of the prickly pear display their true character by becoming woody in texture and losing their articulated leaf-like appearance.

Everything on this earth can best be understood by

investigating the history of its origin and development, and in order to understand this curious reversal of the ordinary rule in the cactus tribe we must look at the circumstances under which the race was evolved in the howling waste of American deserts. (All deserts have a prescriptive right to howl, and I wouldn't for worlds deprive them of the privilege.) Some familiar analogies will help us to see the utility of this arrangement. Everybody knows our common English stone-crops—or if he doesn't he ought to, for they are pretty and ubiquitous. Now stone-crops grow for the most part in chinks of the rock or thirsty sandy soil; they are essentially plants of very dry positions. Hence they have thick and succulent little stems and leaves, which merge into one another by imperceptible gradations. All parts of the plant alike are stumpy, green, and cylindrical. If you squash them with your finger and thumb you find that though the outer skin or epidermis is thick and firm, the inside is sticky, moist, and jelly-like. The reason for all this is plain; the stone-crops drink greedily by their roots whenever they get a chance, and store up the water so obtained to keep them from withering under the hot and pitiless sun that beats down upon them for hours in the baked clefts of their granite matrix. It's the camel trick over again. So leaves and stem grow thick and round and juicy within; but outside they are enclosed in a stout layer of epidermis, which consists of empty glassy cells, and which can be peeled off or flayed with a knife like the skin of an animal. This outer layer prevents evaporation, and is a marked feature of all succulent

plants which grow exposed to the sun on arid rocks or in sandy deserts.

The tendency to produce rounded stems and leaves, little distinguishable from one another, is equally noticeable in many seaside plants which frequent the strip of thirsty sand beyond the reach of the tides. That belt of dry beach that stretches between high-water mark and the zone of vegetable mould, is to all intents and purpose a miniature desert. True, it is watered by rain from time to time; but the drops sink in so fast that in half an hour, as we know, the entire strip is as dry as Sahara again. Now there are many shore weeds of this intermediate sand-belt which mimic to a surprising degree the chief external features of the cactuses. One such weed, the common salicornia, which grows in sandy bottoms or hollows of the beach, has a jointed stem, branched and succulent, after the true cactus pattern, and entirely without leaves or their equivalents in any way. Still more cactus-like in general effect is another familiar English seaside weed, the kali or glasswort, so called because it was formerly burnt to extract the soda. The glasswort has leaves, it is true, but they are thick and fleshy, continuous with the stem, and each one terminating in a sharp, needle-like spine, which effectually protects the weed against all browsing aggressors.

Now, wherever you get very dry and sandy conditions of soil, you get this same type of cactus-like vegetation—*plantes grasses*, as the French well call them. The species which exhibit it are not necessary related to one another in any way; often they belong to

most widely distinct families; it is an adaptive resemblance alone, due to similarity of external circumstances only. The plants have to fight against the same difficulties, and they adopt for the most part the same tactics to fight them with. In other words, any plant of whatever family, which wishes to thrive in desert conditions, must almost, as a matter of course, become thick and succulent, so as to store up water, and must be protected by a stout epidermis to prevent its evaporation under the fierce heat of the sunlight. They do not necessarily lose their leaves in the process; but the jointed stem usually answers the purpose of leaves under such conditions far better than any thin and exposed blade could do in the arid air of a baking desert. And therefore, as a rule, desert plants are leafless.

In India, for example, there are no cactuses. But I wouldn't advise you to dispute the point with a peppery, fire-eating Anglo-Indian colonel. I did so once, myself, at the risk of my life, at a *table d'hôte* on the Continent; and the wonder is that I'm still alive to tell the story. I had nothing but facts on my side, while the colonel had fists, and probably pistols. And when I say no cactuses, I mean, of course, no indigenous species; for prickly pears and epiphyllums may naturally be planted by the hand of man anywhere. But what people take for thickets of cactus in the Indian jungle are really thickets of cactus-like spurges. In the dry soil of India, many spurges grow thick and succulent, learn to suppress their leaves, and assume the bizarre forms and quaint jointed appearance of the true cactuses. In flower and fruit,

however, they are euphorbias to the end; it is only in the thick and fleshy stem that they resemble their nobler and more beautiful Western rivals. No true cactus grows truly wild anywhere on earth except in America. The family was developed there, and, till man transplanted it, never succeeded in gaining a foothold elsewhere. Essentially tropical in type, it was provided with no means of dispersing its seeds across the enormous expanse of intervening ocean which separated its habitat from the sister continents.

But why are cactuses so almost universally prickly? From the grotesque little melon-cactuses of our English hothouses to the huge and ungainly monsters which form miles of hedgerows on Jamaican hillsides, the members of this desert family are mostly distinguished by their abundant spines and thorns, or by the irritating hairs which break off in your skin if you happen to brush incautiously against them. Cactuses are the hedgehogs of the vegetable world; their motto is *Nemo me impune lacessit*. Many a time in the West Indies I have pushed my hand for a second into a bit of tangled 'bush,' as the negroes call it, to seize some rare flower or some beautiful insect, and been punished for twenty-four hours afterwards by the stings of the almost invisible and glass-like little cactus-needles. When you rub them they only break in pieces, and every piece inflicts a fresh wound on the flesh where it rankles. Some of the species have large, stout prickles; some have clusters of irritating hairs at measured distances; and some rejoice in both means of defence at once,

scattered impartially over their entire surface. In the prickly pear, the bundles of prickles are arranged geometrically with great regularity in a perfect quincunx. But that is a small consolation indeed to the reflective mind when you've stung yourself badly with them.

The reason for this bellicose disposition on the part of the cactuses is a tolerably easy one to guess. Fodder is rare in the desert. The starving herbivores that find themselves from time to time belated on the confines of such thirsty regions would seize with avidity upon any succulent plant which offered them food and drink at once in their last extremity. Fancy the joy with which a lost caravan, dying of hunger and thirst in the byways of Sahara, would hail a great bed of melons, cucumbers, and lettuces! Needless to say, however, under such circumstances melon, cucumber, and lettuce would soon be exterminated: they would be promptly eaten up at discretion without leaving a descendant to represent them in the second generation. In the ceaseless war between herbivore and plant, which is waged every day and all day long the whole world over with far greater persistence than the war between carnivore and prey, only those species of plant can survive in such exposed situations which happen to develop spines, thorns, or prickles as a means of defence against the mouths of hungry and desperate assailants.

Nor is this so difficult a bit of evolution as it looks at first sight. Almost all plants are more or less covered with hairs, and it needs but a slight thickening at the base, a slight woody deposit

at the point, to turn them forthwith into the stout prickles of the rose or the bramble. Most leaves are more or less pointed at the end or at the summits of the lobes; and it needs but a slight intensification of this pointed tendency to produce forthwith the sharp defensive foliage of gorse, thistles, and holly. Often one can see all the intermediate stages still surviving under one's very eyes. The thistles, themselves, for example, vary from soft and unarmed species which haunt out-of-the-way spots beyond the reach of browsing herbivores, to such trebly-mailed types as that enemy of the agricultural interest, the creeping thistle, in which the leaves continue themselves as prickly wings down every side of the stem, so that the whole plant is amply clad from head to foot in a defensive coat of fierce and bristling spearheads. There is a common little English meadow weed, the rest-harrow, which in rich and uncropped fields produces no defensive armour of any sort; but on the much-browsed-over suburban commons and in similar exposed spots, where only gorse and blackthorn stand a chance for their lives against the cows and donkeys, it has developed a protected variety in which some of the branches grow abortive, and end abruptly in stout spines like a hawthorn's. Only those rest-harrows have there survived in the sharp struggle for existence which happened most to baffle their relentless pursuers.

Desert plants naturally carry this tendency to its highest point of development. Nowhere else is the struggle for life so fierce; nowhere else is the enemy so goaded by hunger and thirst

to desperate measures. It is a place for internecine warfare Hence, all desert plants are quite absurdly prickly. The starving herbivores will attack and devour under such circumstances even thorny weeds, which tear or sting their tender tongues and palates, but which supply them at least with a little food and moisture: so the plants are compelled in turn to take almost extravagant precautions. Sometimes the leaves end in a stout dagger-like point, as with the agave, or so-called American aloe; sometimes they are reduced to mere prickles or bundles of needle-like spikes; sometimes they are suppressed altogether, and the work of defence is undertaken in their stead by irritating hairs intermixed with caltrops of spines pointing outward from a common centre in every direction. When one remembers how delicately sensitive are the tender noses of most browsing herbivores, one can realize what an excellent mode of defence these irritating hairs must naturally constitute. I have seen cows in Jamaica almost maddened by their stings, and even savage bulls will think twice in their rage before they attempt to make their way through the serried spears of a dense cactus hedge. To put it briefly, plants have survived under very arid or sandy conditions precisely in proportion as they displayed this tendency towards the production of thorns, spines, bristles, and prickles.

It is a marked characteristic of the cactus tribe to be very tenacious of life, and when hacked to pieces, to spring afresh in full vigour from every scrap or fragment. True vegetable hydras, when you cut down one, ten spring in its place: every separate

morsel of the thick and succulent stem has the power of growing anew into a separate cactus. Surprising as this peculiarity seems at first sight, it is only a special desert modification of a faculty possessed in a less degree by almost all plants and by many animals. If you cut off the end of a rose branch and stick it in the ground under suitable conditions, it grows into a rose tree. If you take cuttings of scarlet geraniums or common verbenas, and pot them in moist soil, they bud out apace into new plants like their parents. Certain special types can even be propagated from fragments of the leaf; for example, there is a particularly vivacious begonia off which you may snap a corner of one blade, and hang it up by a string from a peg or the ceiling, when, hi, presto! little begonia plants begin to bud out incontinently on every side from its edges. A certain German professor went even further than that; he chopped up a liverwort very fine into vegetable mincemeat, which he then spread thin over a saucerful of moist sand, and lo! in a few days the whole surface of the mess was covered with a perfect forest of sprouting little liverworts. Roughly speaking, one may say that every fragment of every organism has in it the power to rebuild in its entirety another organism like the one of which it once formed a component element.

Similarly with animals. Cut off a lizard's tail, and straightway a new tail grows in its place with surprising promptitude. Cut off a lobster's claw, and in a very few weeks that lobster is walking about airily on his native rocks, with two claws as usual. True,

in these cases the tail and the claw don't bud out in turn into a new lizard or a new lobster. But that is a penalty the higher organisms have to pay for their extreme complexity. They have lost that plasticity, that freedom of growth, which characterizes the simpler and more primitive forms of life; in their case the power of producing fresh organisms entire from a single fragment, once diffused equally over the whole body, is now confined to certain specialized cells which, in their developed form, we know as seeds or eggs. Yet, even among animals, at a low stage of development, this original power of reproducing the whole from a single part remains inherent in the organism; for you may chop up a fresh-water hydra into a hundred little bits, and every bit will be capable of growing afresh into a complete hydra.

Now, desert plants would naturally retain this primitive tendency in a very high degree; for they are specially organized to resist drought—being the survivors of generations of drought-proof ancestors—and, like the camel, they have often to struggle on through long periods of time without a drop of water. Exactly the same thing happens at home to many of our pretty little European stone-crops. I have a rockery near my house overgrown with the little white sedum of our gardens. The birds often peck off a tiny leaf or branch; it drops on the dry soil, and remains there for days without giving a sign of life. But its thick epidermis effectually saves it from withering; and as soon as rain falls, wee white rootlets sprout out from the under side of the fragment as

it lies, and it grows before long into a fresh small sedum plant. Thus, what seem like destructive agencies themselves, are turned in the end by mere tenacity of life into a secondary means of propagation.

That is why the prickly pear is so common in all countries where the climate suits it, and where it has once managed to gain a foothold. The more you cut it down, the thicker it springs; each murdered bit becomes the parent in due time of a numerous offspring. Man, however, with his usual ingenuity, has managed to best the plant, on this its own ground, and turn it into a useful fodder for his beasts of burden. The prickly pear is planted abundantly on bare rocks in Algeria, where nothing else would grow, and is cut down when adult, divested of its thorns by a rough process of hacking, and used as food for camels and cattle. It thus provides fresh moist fodder in the African summer when the grass is dried up and all other pasture crops have failed entirely.

The flowers of the prickly pear, as of many other cactuses, grow apparently on the edge of the leaves, which alone might give the observant mind a hint as to the true nature of those thick and flattened expansions. For whenever what look like leaves bear flowers or fruit on their edge or midrib, as in the familiar instance of butcher's broom, you may be sure at a glance they are really branches in disguise masquerading as foliage. The blossoms in the prickly pear are large, handsome, and yellow; at least, they would be handsome if one could ever see them, but they are

generally covered so thick in dust that it is difficult properly to appreciate their beauty. They have a great many petals in numerous rows, and a great many stamens in a rosette in the centre; and, to the best of my knowledge and belief, as lawyers put it, they are fertilized for the most part by tropical butterflies; but on this point, having observed them but little in their native habitats, I speak under correction.

The fruit itself, to which the plant owes its popular name, is botanically a berry, though a very big one, and it exhibits in a highly specialized degree the general tactics of all its family. As far as their leaf-like stems go, the main object in life of the cactuses is—not to get eaten. But when it comes to the fruit, this object in life is exactly reversed; the plant desires its fruit to be devoured by some friendly bird or adapted animal, in order that the hard little seeds buried in the pulp within may be dispersed for germination under suitable conditions. At the same time, true to its central idea, it covers even the pear itself with deterrent and prickly hairs, meant to act as a defence against useless thieves or petty depredators, who would eat the soft pulp on the plant as it stands (much as wasps do peaches) without benefiting the species in return by dispersing its seedlings. This practice is fully in accordance with the general habit of tropical or sub-tropical fruits, which lay themselves out to deserve the kind offices of monkeys, parrots, toucans, hornbills, and other such large and powerful fruit-feeders. Fruits which arrange themselves for a *clientèle*, of this character have usually thick or nauseous rinds,

prickly husks, or other deterrent integuments; but they are full within of juicy pulp, embedding stony or nutlike seeds, which pass undigested through the gizzards of their swallowers.

For a similar reason, the actual prickly pears themselves are attractively coloured. I need hardly point out, I suppose, at the present time of day, that such tints in the vegetable world act like the gaudy posters of our London advertisers. Fruits and flowers which desire to attract the attention of beasts, birds, or insects, are tricked out in flaunting hues of crimson, purple, blue, and yellow; fruits and flowers which could only be injured by the notice of animals are small and green, or dingy and inconspicuous.

PRETTY POLL

It is an error of youth to despise parrots for their much talking. Loquacity isn't always a sign of empty-headedness, nor is silence a sure proof of weight and wisdom. Biologists, for their part, know better than that. By common consent, they rank the parrot group as the very head and crown of bird creation. Not, of course, because pretty Poll can talk (in a state of nature, parrots only chatter somewhat meaninglessly to one another), but because the group display on the whole, all round, a greater amount of intelligence, of cleverness, and of adaptability to circumstances than any other birds, including even their cunning and secretive rivals, the ravens, the jackdaws, the crows, and the magpies.

What are the efficient causes of this exceptionally high intelligence in parrots? Well, Mr. Herbert Spencer, I believe, was the first to point out the intimate connection that exists throughout the animal world between mental development and the power of grasping an object all round so as to know exactly its shape and its tactile properties. The possession of an effective prehensile organ—a hand or its equivalent—seems to be the first great requisite for the evolution of a high order of intellect. Man and the monkeys, for example, have a pair of hands; and in their case one can see at a glance how dependent is their intelligence upon these grasping organs. All human arts base themselves ultimately upon the human hand; and even the apes

approach nearest to humanity in virtue of their ever-active and busy little fingers. The elephant, again, has his flexible trunk, which, as we have all heard over and over again, *usque ad nauseam*, is equally well adapted to pick up a pin or to break the great boughs of tropical forest trees. (That pin, in particular, is now a well-worn classic.) The squirrel, once more, celebrated for his unusual intelligence when judged by a rodent standard, uses his pretty little paws as veritable hands, by which he can grasp a nut or fruit all round, and so gain in his small mind a clear conception of its true shape and properties. Throughout the animal kingdom generally, indeed, this correspondence, or rather this chain of causation, makes itself everywhere felt; no high intelligence without a highly developed prehensile and grasping organ.

Perhaps the opossum is the very best and most crucial instance that could possibly be adduced of the intimate connection which exists between touch and intellect. For the opossum is a marsupial; it belongs to the same group of lowly-organized, antiquated, and pouch-bearing animals as the kangaroo, the wombat, and the other belated Australian mammals. Now everybody knows the marsupials as a class are nothing short of preternaturally stupid. They are just about the very dullest and silliest of all existing quadrupeds. And this is reasonable enough, when one comes to think of it, for they represent a very antique and early type, the first rough sketch of the mammalian idea, if I may so describe them, with wits unsharpened as yet by contact

with the world in the fierce competition of the struggle for life as it displays itself on the crowded stage of the great continents. They stand, in short, to the lions and tigers, the elephants and horses, the monkeys and squirrels, of Europe and America, as the Australian blackfellow stands to the Englishman or the Yankee. They are the last relic of the original secondary quadrupeds, stranded for ages in a remote southern island, and still keeping up among Australian forests the antique type of life that went out of fashion in Europe, Asia, and America before the chalk was laid down or the London Clay deposited on the bed of our northern oceans. Hence they have still very narrow brains, and are so extremely stupid that a kangaroo, it is said—though I don't vouch for it myself—when struck a smart blow, will turn and bite the stick that hurts him instead of expending his anger on the hand that holds it.

Конец ознакомительного фрагмента.