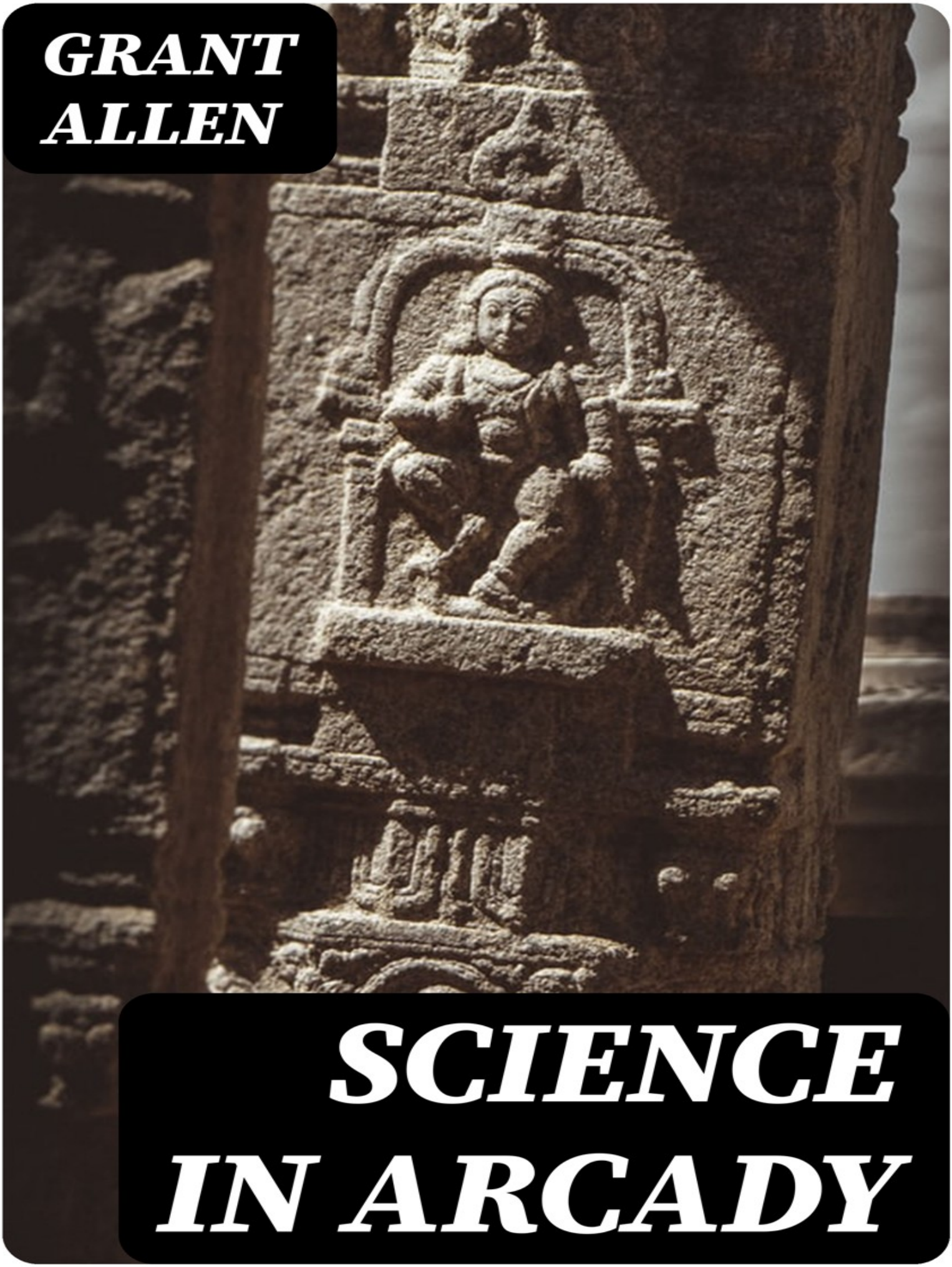
GRANT ALLEN



SCIENCE IN ARCADY

Grant Allen

Science in Arcady

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Contact: DigiCat@okpublishing.info

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PREFACE.

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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.

SCIENCE IN ARCADY.

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MY ISLANDS.

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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.

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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